THE

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ELECTRICAL REVIEW.

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THE

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PARLIAMENT AND POST OFFICE.

THE discussion on the Report of the Bradford Commission has prompted a correspondent of the *Times* to suggest, in an article entitled "The Wages of Public Servants," the possible need of disfranchisement of civil servants and municipal employés, with a view to the avoidance of electoral pressure for obtaining increased pay. In a leading article on this communication from its "well-informed correspondent," the *Times* urges that as nearly every public servant in receipt of wages is an elector, it follows that if they choose to combine they can bring an amount of pressure to bear upon the House of Commons which it may be very difficult for the State to resist. The example of the dockyard constituencies is referred to, but it recognises that this example affects only two or three constituencies, while the voting influence of Post Office employés is much more widely diffused. There is scarcely a constituency that is not more or less affected by it. In some it is able to decide an election, and in nearly all can bring pressure to bear. Another well-informed correspondent representing the interests of postal employés, says the remarks with reference to the alleged intimidation of Members of Parliament by telegraphists savour of grim irony. For nearly 20 years the telegraphists have been asking, without success, for one concession—the appointment of a Select Committee of the Commons to investigate the causes of discontent. He says, further, that the Joint Committee of Postal Organisations only claims to represent 40,000 members, including women. Many of the males are young, and have no vote, but if every one was an elector the number is an insignificant fraction of the community, and, spread over 600 constituencies, cannot control a single election.

That any one class may obtain an undue share of representation or influence in Parliament has always been the fear of every other class. It is a popular superstition largely believed in by tenants that the laws are made by landlords, and most laymen agree that there are too many lawyer members: the interests of labour are supposed to be trampled under foot by the tyranny of Parliamentary employers, and employers shudder at what must happen if labour members increase: there are too many directors, or not enough practical men to represent particular industries. There are no limits to the complaints of what is, or the fears of what may be, but somehow the predicted consequences do not shatter the fabric of State, and though there are many occasions when the "wisdom of Parliament" does not seem to be dazzling in its brilliance, the representative character of the House of Commons remains unimpaired. We believe the fear of Parliamentary pressure by the voting power of Post Office servants to be as groundless as many other fears of a like kind which have preceded

it. The diffusion to which the *Times* refers, is not a danger, but a safeguard. An increase in State employment differs from local-government employment. The narrower boundaries of municipalities, the condition frequently made that employés must reside within the boundaries, and the closer relationship between elector and representative, might conduce to the exercise of voting power for personal benefit to a degree which suggests the desirability of not extending unduly the activities of municipalities in directions which employ considerable labour. The greater dispersion of Postal servants, and the wider area of representation, are safeguards to the State against undue influence by voting power.

But though the danger of power by representation does not exist, there remains the power of irritation. As the controller of the purse strings, Parliament is the final court of appeal for any one who has a grievance against a Government department. When a member raises the question of the adequacy of a telegraphist's wage, or inquires the origin of the pencil which the telegraphist uses, the House is fairly well able to judge the disinterestedness of his motives, or the importance to be attached to his facts. It would be well if the Post Office and other Government departments could be relieved from this Parliamentary irritation, but as this probably could not be done without trenching on the sacred rights of the House of Commons, reliance must be placed on the good sense of the majority discouraging trivial questions, and giving the Postmaster-General a fairly free hand in matters relating to his staff. This can be done without Parliament in any way renouncing its control or omitting to ensure that no well-founded grievance goes unredressed. But before appealing to the confidence of Parliament it is very desirable that the Postmaster-General should have confidence in the ability of his department and himself to manage their own affairs. The late Postmaster-General, Mr. Austen Chamberlain, with a view to obtaining a settlement of the grievances of Postal servants, appointed a Committee to inquire and report. In one important particular the Committee preferred to report without inquiry, and did so in such a way as to enable the employés to claim with some plausibility that the verdict was in their favour. The present Postmaster-General declined to carry out the recommendations of the Committee, and the efforts of the aggrieved parties to obtain Parliamentary support have given occasion to the *Times* to indulge in those fears to which we have referred. Into the merits of the case we cannot now enter, but we see no occasion to anticipate Parliamentary paralysis, because a trades union of Civil servants attempts to promote its own interests by circularising members of Parliament. The Committee were asked to compare the wages of employés under private enterprise with those of the State. There is, of course, no exact equivalent for a postal servant, but there are telegraphists in private employ. It is to be regretted that the Committee did not carry out the terms of their reference and make the comparison required. It would have been of interest to learn, on authority, whether the wages, the hours of duty, and the conditions of employment generally, of telegraphists in the employ of cable companies, for instance, were better than those of the State. On the whole, we fear not; but the inexorable law of supply and demand settles their case. Much as we should like to see the status of the telegraphist raised, and his pay increased, we cannot view with satisfaction the creation of a privileged class paid, out of the taxpayers' pocket, a wage above the market rate. In the higher offices of the postal service it is very generally recognised that the emoluments are less than the qualifications would obtain under private enterprise, but that the permanence of employment and the official position are compensations to be taken into account. The question is, whether these compensations have also been taken into account by the Postal Trade Union?

The latitude which is allowed to employés is shown by the existence of this union and its unrestricted operations. We believe that the officials of the Department recognise their responsibility both to the State and their employés. They ought to be better informed on their own particular work than the manager of a stores or a Commissioner of Police. The Postmaster-General has to face the implied fact that his predecessor was not satisfied as to this. But let him satisfy himself and then appeal to Parliament with confidence in their decision. We do not believe that the voting power of postal employés will, either now or in the future, have any effect on the action of members. That the employés should have their advocates in the House is only reasonable. But they will be advocates. The members, as a whole, will be the judges. And the judges, we believe, will be unbiassed by voting influence, and will consider that discontent expressed by an organised body is not in itself sufficient to justify a further dip into the national purse.

Fire Alarms.

The International Fire Service Congress, which was held at Budapest, and was an eminently successful conference, had the benefit of several contributions from the British delegates who were attending the meeting in the form of a special commission organised by the British Fire Prevention Committee. Among these contributions there was a paper by Mr. James Sheppard, insurance surveyor, on the development and importance of fire calls and alarms, a topic which should eminently appeal to the electrical engineer, so we are presenting an abstract of this paper elsewhere. Mr. Sheppard's paper had the particular distinction of being the best discussed paper of the conference, men of such standing as Chief Officer Giersberg, of the Berlin Royal Police Brigade, Commandant Welsch, of the Ghent Fire Brigade, and other gentlemen of considerable technical reputation participating in the debate.

No matter how efficient a fire brigade, the importance of suitable means of calling its assistance cannot be overrated, and what applies to the large cities applies almost equally as much to the provincial districts and to the individual risk of the factory or mill.

It might be well to take this opportunity to call attention to the useful and representative character of the Special Commission delegated by the British Fire Prevention Committee that visited Budapest, and at the same time took occasion to carefully inspect the fire preventive arrangements of various other cities *en route*.

The Commission comprised architects, insurance and building surveyors, professional and volunteer fire service and salvage officers. The Chairman of the British Fire Prevention Committee acted as chairman of the Commission, and the honorary secretaries of the Committee and the National Fire Brigades' Union, respectively, acted as joint honorary secretaries.

It is anticipated that the result of the work of this Commission will be embodied in a special report. The distance travelled was considerable, and the towns visited numerous, but throughout the members of the Commission had the particular facilities of the aid of our British consular body, and of the very open-handed assistance accorded them in all the towns visited by the local authorities.

Efficient Braking.

We learn from the *Street Railway Review* for August that the Westinghouse Traction Brake Co. are publishing a pamphlet calling attention to the urgent need for the better instruction of student motormen in the use of the air-brake. It is stated that the usual dummy car in the school of instruction is equipped with the hand-brake only, so that the student has to learn how to handle the air-brake, which is fitted so commonly to American cars, when on a service car, with the result that the lesson is half-taught and badly learnt.

Illustrating this, an instructive diagram is printed showing how a motorman, ignorant on this matter, will bring his car to a stop by admitting air to the brake cylinder by successive increments of about 5 lbs., until the maximum pressure is in the cylinder when the car has stopped, whereas the properly trained man will give a high initial pressure, which will be reduced as deceleration proceeds, thereby obtaining a quicker stop with less inconvenience to the passengers than the first jerky procedure ensures.

It is true that air-brakes are not in general use on English tramcars, but the moral is the same whatever the type of brake—time spent in sound instruction at the outset is repaid with high interest in the end. Teach your men how to brake under all the conditions which they are going to encounter at one time or another, and teach them well. You will reduce your accidents, your maintenance account, and your consumption of energy.

The Temperature Coefficient of Copper Conductors.

We recently drew attention to the important Tables of Standards for Copper Conductors issued by the Engineering Standards Committee, and pointed out that the fundamental standards adopted were practically identical with those authorised by the Committee on Copper Conductors in 1899. It escaped our notice at the time, but has since come to our knowledge, that in paraphrasing the report of the latter Committee an important change was made in connection with the resolution defining the temperature coefficient. The original clause read as follows :—

That Messrs. Clark, Forde & Taylor's temperature coefficient, *as published in their pamphlet* dated February 20th, 1899, be adopted, and that the average coefficient of 0·00238 per degree F. be adopted for commercial purposes.

The Standards Committee's resolution reads :—

Resolved that the average temperature coefficient of 0 00238 per degree F. (0·00428 per degree C.) be adopted for commercial purposes.

It will be observed that the words which we have italicised in the former have been ignored in the latter version, and this omission renders the occurrence of serious errors highly probable. In their pamphlet, Messrs. Clark, Forde and Taylor show clearly *how* the coefficient is to be employed, their shortened formula taking the form—

$$\frac{R_t}{R_{32}} = 1 + 0{\cdot}002386\ (t - 32),$$

and the resistance correction must be made, *not* by adding 0·238 per cent. for each degree of temperature rise, but by applying the above formula.

The whole matter will be found fully discussed in a pamphlet on "The Conductometer and Electrical Conductivity," by Mr. Rollo Appleyard, based upon articles which he contributed to our pages ; he there shows that while the average temperature coefficient between 32° and 42° F. is 0·002374, on the other hand, between 72° and 82° it becomes 0·002402, and between 92° and 102°, 0·002416. It is obvious, therefore, that unless the Committee's resolution be amended, so as to embody the correct method of calculating the increase of resistance with temperature, errors of by no means negligible amounts may readily be incurred.

AIR LIFT PUMPS.

By W. H. BOOTH.

The air lift pump is gradually forcing its way into use, though it possesses the disadvantage of requiring considerably more power to work it than is required for plain lift pumps. The particular and peculiar advantage of the air-lift pump lies in the fact that it does its work without a single piece of moving machinery being placed below the surface of the earth, and it can be worked at any reasonable distance from a central source of power.

For the sake of those who are not acquainted with this pump, a brief description may be given of the principle on which it works, and this will readily be understood by the aid of the sketch.

Let it be supposed that W is the liner of an artesian well in which when no water is being pumped, the rest level of the water is at R . L. Calculation of the yield shows that when a given quantity of water is being drawn from the well, the water level will stand at W L. Then x is the head which yields the given flow. As the flow of water varies with the square root of the head of supply, the output of a well is determined from $\sqrt{x} : \sqrt{y}$, where y is the value of x for some known and actually tested rate of yield. Having found y, we can then fix the value of x very approximately.

A rising main M is inserted down the borehole to a depth d, below the yield level W L. Inside this pipe a small pipe, A, is carried down to the same depth. If the pipe A were filled with oil, the level of the oil would stand above the rest level R L of the water about 20 per cent. of the distance, D, before any oil escaped at the perforations at the base of pipe A. By continuing to pour in oil, it would escape at the perforations, and would rise in drops through the water in the annular space between the two pipes A and M, forming a column of mixed oil and water of a mean specific gravity less than water. Therefore the liquid in this annular space would rise above the level R L, and if it could flow away at that point to which it rises, we could draw water out of the well simply by pouring oil down the pipe, A, sufficiently quickly for the oil to form a series of water-separated plugs in the pipe M.

What we have done is simply to produce a liquid column of less specific gravity than water, and the solid water column balances a greater length of the liquid of lighter specific gravity. Using the same apparatus, we pump air down the pipe A. The air forces out the water, and finally escapes at the perforations, compressed to the pressure equivalent to a head of water, D. The air compressor must thus be capable of getting up a pressure in lb. per sq. in. equal to 0·43 D where D is measured in feet. Escaping into the pipe M, the air forms itself apparently into plugs, with plugs of water alternating. As the air rises, it expands as the pressure upon it becomes less, and the plugs lengthen and do work in lifting the water equivalent to the work done in compressing the air, less the heat of compression which is lost. If the outlet of the rising main is at O, we must then have the united length of all the water plugs in the height H of rising main, less than the height d between the foot-piece and the level W L at which the water now stands, for it will fall the distance x during pumping—that is to say, the pressure of the solid column of water d must exceed that of the mixed column H before we can get an outflow at O.

This is said to be obtained in practice when the height d is from 1·5 K to 2 K.

If, for argument, we assume $d = 2$ K, then the length of air-plugs in the length H must be more than the length K. If just of the length K, the outer column d would only just balance the inner column H, and there would be no flow. The weight of the air-plugs may be neglected.

In the pipe M, up which the air and water escape, the air starts from the bottom at the absolute pressure $p = 0{\cdot}43\ d + 14{\cdot}7$, and it escapes practically at atmospheric pressure at the discharge point O, its last remnant of pressure being converted into projectile energy of the water which is shot out at some velocity.

As the air has to travel up the iron pipe with the pumped water, it can safely be said that the expansion will be iso-

thermal, the expanding air taking up heat all along its path, and the mean pressure in the length H must, therefore, be $p \times \frac{1 + \text{hyp log } r}{r}$, where p is the initial pressure $= 0{\cdot}43d + 14{\cdot}7$, and r is the number of expansions or the number of atmospheres equivalent to p. Thus $r = 1 + \frac{0{\cdot}43\ d}{14{\cdot}7}$, or very nearly $1 + \frac{d}{34}$. Thus, if we find a value for $d =$ 68 ft., we have $p = (68 \times 0{\cdot}43) + 14{\cdot}7 = 44{\cdot}1$; then $r = \frac{29{\cdot}4}{14{\cdot}7} + 1 = 3$ atmospheres, and, of course, 3 expansions in escaping.

As the value d will always be given in feet, the mean air pressure in the rising main may be found by a formula based on d, and this we may write—

$$\text{Mean pressure} = p\left\{\frac{1 + \log_e\left(1 + \frac{d}{34}\right)}{1 + \frac{d}{34}}\right\}$$

For the assumed value of $d = 68$ ft. this becomes $44{\cdot}1\left\{\frac{1 + \log_e 3}{3}\right\}$ or $44{\cdot}1\left(\frac{2{\cdot}1}{3}\right) =$ nearly 31 lbs. absolute.

Practically, the air will in this case occupy a bulk fully double its normal, and as we have found that it must fill a length = K of the rising main, we must pump in fully double this air when measured at normal atmospheric pressure.

In other words, if $d = 2$ K the bulk of atmospheric air forced in must be the same as that of the water it will raise. Frictional resistances and the residual or final energy in the escaping water and air all go to reduce the efficiency and render it necessary to force more air than the above calculation shows to be a theoretical minimum.

The difficulties and desirabilities of the system are as follows :—Except in very copious wells the value of x is quite considerable ; it may be as much as 50 ft. in a London well. In starting to pump, the air pressure must overcome the pressure of a head of water = D, but as soon as flow is established the water level begins to fall until it reaches the supply level, M, and the pressure of air at the compressor of course falls by the equivalent of x, and the power to compress the air is correspondingly reduced. The driving power may sometimes be necessarily much greater than is needed during pumping, and where the yield drop, x, is large the plant outlay is made somewhat excessive.

Though the air expands isothermally, it cannot so readily be compressed on an isothermal, because the exposed surfaces of the compressor bear a much less ratio to the air volume than does the surface exposed in the rising main. Practically, the expansion takes place at 50°, this being a degree or two colder than all artesian water supplies from ordinary depths.

In the adiabatic compression of air the heat in foot-lbs. generated in compression from p_0 to p is—

$$\frac{\text{A}\ t_0}{y-1}\left\{\left(\frac{p}{p_0}\right)^{\frac{y-1}{y}} - 1\right\} \quad \text{where } y = 1{\cdot}408$$

A $= 53{\cdot}15$ t_0, p_0 and p are respectively the absolute atmospheric temperature, the atmospheric pressure and the reservoir pressure.

The heat generated increases the volume of the compressed air, and would be all recovered if the air were made to expand without being cooled down.

In fig. 2, if O V_0 be the curve for compression of air isothermally, O V_1 will represent its adiabatic compression, and its final volume becomes V V_1 instead of V V_0. The difference represents work wasted and to be economised by cooling the compression cylinder.

By means of compound compression or stage compression with good intermediate cooling, the efficiency of compression is much improved. Thus where $p = 4$ atmospheres, the efficiency of one stage compression and expansion is ·669, of two stage ·817. At 50 atmospheres the numbers are ·322 and ·567, with a three stage efficiency of ·685, showing considerable advantage in stage compression. Probably the actual curve in fig. 2 will lie between the other curves, because some cooling goes on during compression. The probable curve is shown dotted. At six atmospheres the loss of ideal adiabatic compression is about 25 per cent., and an ideal two-stage compression has about 12 per cent. loss. Both these losses are reduced by cooling, but cannot in ordinary practice be brought down to the line V V_0. In an artesian well, with practically isothermal expansion, the volume of air which starts at V V_0 will expand

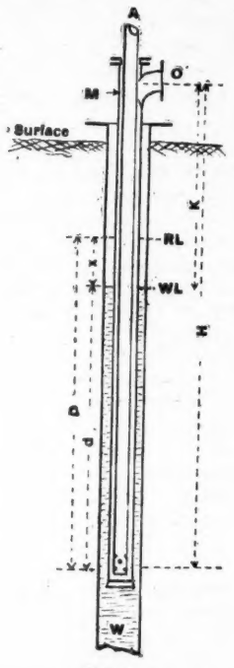


Fig. 1.

along the isothermal V_0 O, simply because it absorbs heat from the water. Did it not absorb heat a volume = V V_1, would be necessary, expanding along the curve V_1 O. Therefore, in the air-lift pump, though there is the usual loss, due to partially adiabatic compression, some of the work of raising the water is actually obtained from the water itself in the form of heat.

The higher the pressure necessary, or the greater the height K in fig. 1, the greater will be the benefit of stage compression. A second disadvantage of air-lift pumps is

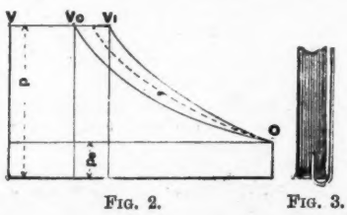


Fig. 2.

Fig. 3.

the large ratio of d : K that is necessary. This disability is serious when the depth K is great. In London the depth K is often as much as 150 ft. If K is measured from the surface and $d = 2$ K, the height H must be 3 K = 450 ft. A London artesian well only requires to be from 300 to 400 ft. in depth, so that with the above conditions the necessary depth for yielding the water supply is less than that for the pump. At the works of the South London Electric Supply Co., which are rather beyond the so-called London basin, the level R L is only about 70 ft. below surface, and the additional head, x, necessary to give the yield was only so much as permitted of the pump extending about 320 ft. below surface, while, at the same time, K was measured from a point nearly 30 ft. above surface. The pump, in fact, delivers to the raised tank.

The advantages of the air-lift pump are as follows :—First, there is nothing but plain pipe down the bore-hole. Secondly, the machinery may be any distance away from the bore-hole so long as the air pipe is tightly jointed. Thirdly, the maximum yield of a well can be got out of a smaller and

cheaper hole. The yield of a deep well pump is the measure of the capacity of the bore-hole, and a 6,000-gallon pump calls for a 10-in. lined hole, whereas the same yield can be got out of a 6-in. or less hole by the air-lift system.

The arrangement of fig. 1 may be reversed, air being forced down the pipe M and water rising up the pipe A, or the air pipe may be independent and carried down alongside of the rising main with a turned-up nozzle, as in fig. 3.

As in many cases the pipes are carried down past some or all of the water bearing horizons, care should be taken that the outside diameter of the largest pipe is sufficiently less than the diameter of the bore hole to permit the water to descend and reach the foot piece or the yield may be crippled. By noting the pressure gauge on the air reservoir, there can be found from its maximum reading whether any change in the height D occurs. Similarly the gauge tells when pumping is going on steadily, what is the height d, and consequently the value of $x = D - d$. If x is found to be less than anticipated, an economy of power may be effected by reducing the total depth H which should be a minimum. If the yield of a well is insufficient for the size of pipes employed the working will be spasmodic, and if A has been made the rising main, as it perhaps had better be, its diameter may with advantage be reduced. A rising main too large for the flow of water will fail to act altogether, for the air plugs will break and release the water which will fall back. A certain velocity of flow is necessary to maintain perfect action.

There are within 30 miles of London large areas of water-cress beds supplied from artesian wells. The trade is profitable where the well flows freely through the winter, because the water is warm, 51°, and the cress can be grown in winter by its aid. There are many wells which now stand a few inches only below the overflow point. The application of air lifts to these wells would be cheap. An immersion H of very small amount would alone be necessary, and would demand very little power to produce a copious flow of water. This is an industry not hitherto tapped by power distribution, because the importance and magnitude of the industry are unsuspected. As an example, a well is required to yield 10,000 gallons per hour by itself or in company with others. Its natural head is 1 ft. down, representing 100,000 foot-lb. of work, and failures to flow are common with only 2 in. or 4 in. of short head. The power is thus $\frac{1}{20}$ H.P. net, or, say, $\frac{1}{4}$ H.P. after liberal allowance.

As £100 may easily be expended on cleaning and replanting a frost-killed bed, it is clear that the subject is of more than trivial importance, especially since the overflowing wells about London have been reduced below flow level by the operations of the water companies, sworn statements of the water companies to the contrary notwithstanding.

ON THE HEATING OF THREE-PHASE CABLE SHEATHS.

By M. B. FIELD.

The experimental demonstration of the existence of a torque exerted between the current-carrying conductors and the sheath of a three-phase cable possesses a peculiar fascination, and I feel sure that many readers, in common with myself, will have derived very real pleasure from the perusal of the article on this subject by Mr. J. T. Morris, published in the *Electrician*, September 2nd, 1904.

The details of the experimental investigation referred to are ingenious and well thought out, while the results obtained appear to be consistent, and it is quite probable, as the writer indicates, that the method is capable of much wider application. This being the case, I venture to think that a short discussion of it, more from the mathematical point of view, will not be out of place. The subject of the losses in three-core cable sheaths has been engaging my attention for some little time past, and Mr. Morris has kindly referred to some of the results I have obtained. I trust, therefore, that the following short article will be regarded merely as a further attempt towards the elucidation of a somewhat complex subject, and by no means as a criticism of the admirable investigation by Mr. Morris, which, however, I propose to take as a basis for discussion.

Mr. Morris calls attention to the irregular rotating field existing in the space surrounding a three-phase cable, and points out that this rotating field must tend to drag the sheath round with it. We have, in fact, a case almost analogous to an inverted three-phase induction motor with a squirrel-cage rotor, the stator being inside, and the rotatable member outside. The three cores of the cable correspond to the stator of the motor, the sheath to the external rotor. Mr. Morris, therefore, suspends a portion of the sheath, measures the torque exerted on it, and deduces the loss by multiplying this torque by the angular velocity of the rotating field.

Now, we know that there can be a C^2R loss in the rotor of an induction motor in excess of that represented by the product of the resultant torque and the angular velocity of the rotating field relative to the rotor. We know, for instance, that if the rotor of a single-phase induction motor be stationary and no starting device be employed, no torque will be exerted on the rotor, although considerable C^2R losses may be present. The exact cable analogue would be obtained by placing two cores symmetrically within a cylindrical sheath, and employing these as a single-phase circuit. In this connection, Mr. Morris observes:—"When the current in one of the phases was broken there was, in no case, any torque observed." It is obvious, however, that the absence of torque in no way indicates the absence of eddy currents in the sheath, it merely indicates that two equal and opposite rotating fields exist, producing two equal and opposite torques.

Now, in the three-phase cable case, the rotating field is admittedly "jerky" and irregular, and, this being the case, is it not possible that certain components exist which rotate in the opposite direction to the main field, producing positive C^2R losses but negative torques; or, again, is it not possible that certain components exist which rotate with a speed less than that of the fundamental term? If so, the C^2R losses so produced are *not* represented by the product of the torque exerted and the angular velocity of *the fundamental term*.

I propose to prove, here, the existence of such components rotating not only at sub-multiples of the speed of the main or fundamental field, but also rotating in the opposite sense.

In a series of articles I wrote for the Electrical Review in 1899,* I demonstrated that, however complex the normal component of the induction in the air gap of an induction motor might be, we can always sub-divide it into a number of rotating (sinusoidal) waves of magnetism. Thus, in a motor wound for $2p$ poles, a fundamental wave exists having $2p$ poles rotating at a speed of f/p revolutions per second (where f represents the frequency); further distributions having $4p$, $6p$, $8p$, &c., poles may exist rotating at $\frac{f}{2p}$, $\frac{f}{3p}$, $\frac{f}{4p}$, &c., revolutions per second, and these may be rotating either forwards or backwards. I showed further that these waves of magnetism induce corresponding waves of E.M.F. and current in the conductors of the squirrel-cage rotor, each wave of current, &c, sweeping round with the same velocity as the wave of magnetism inducing it. Since these are precisely the phenomena that occur in the case under consideration, I propose to repeat here some of the definitions I gave in the articles above referred to.

Let us consider the sheath of our three-phase cable immersed in a magnetic field, such that at some particular instant the normal induction is defined by B sin θ, and we have what I term a *sinusoidal distribution of magnetic induction* (radially).

Now let us consider that this distribution, while remaining intact, rotates as a whole about the axis, o, in a clockwise direction, with a speed of f revolutions per second. The normal induction at P will be given by the law — B sin

* The Electrical Review, February 10th and 24th; March 17th and 31st; April 14th, 1899. "On Oscillatory and Rotatory Magnetic Fields and the Theory of the Single-phase Motor." See, also, "Polyphase Electric Currents," 1900 edition, by Prof. S. P. Thompson, F.R.S., pp. 299—307.

$(pt - \theta)$ where $p = 2\pi f$, provided we reckon the zero of time (or $t = o$) at the instant when the induction at Q is zero, and that at the point $\theta = \frac{\pi}{2}$ is + B. If we consider the magnetic distribution to be rotating in the opposite direction, we should have + B sin $(pt + \theta)$ for the value of the normal induction at P. Such rotating sinusoidal distributions of magnetism I call (rotating) *waves of magnetism* or magnetic induction. It must always be remembered that such waves are sinusoidal distributions as regards space, and of constant maximum value, and the only change that occurs is in the angular position of the wave as a whole. If we superimpose a wave rotating clockwise, upon an identical one rotating counter-clockwise, we obtain for the induction at P

$$\text{B sin } (pt + \theta) - \text{B sin } (pt - \theta)$$

or

$$2 \text{ B sin } \theta \cos pt.$$

I have called such a space-time distribution a pulsating or oscillating sinusoidal distribution. Such terms, however, do not occur in the subsequent work of this article, and a further discussion of them is unnecessary.

The distribution of magnetism represented by B sin 2 θ is clearly a sinusoidal distribution of four poles, and B sin 3 θ one of six poles and so on. If now the distribution B sin 2 θ rotate clockwise at a speed of $f/2$ revs. per sec. we have $-$ B sin $(pt - 2\theta)$ for the induction at P, while, if it rotate counter-clockwise the expression is + B sin $(pt + 2\theta)$; similarly the induction at P due to the 6-pole distribution is $\mp$ B sin $(pt \mp 3\theta)$, if it rotate at a speed of $f/3$ revs. per second the upper signs corresponding to clockwise and the lower to counter-clockwise rotation.

These rotating sinusoidal distributions or waves are the simplest components of the complex rotating field, so that if we can express the normal induction at the sheath of a three-phase cable by a series of such terms, we shall have no difficulty in recognising the various rotating components, together with their magnitude, direction of rotation, angular velocity and number of poles.

If instead of normal induction we picture to ourselves current density in the sheath (current flowing axially) or longitudinal E.M.F., we have at once the conception of rotating waves of current, E.M.F., &c. For example, if v be the linear velocity (reckoned at the sheath) of the normal induction, the longitutinal E.M.F. per unit length of sheath at P due to the four-pole distribution is $\mp v$ B sin $(pt \mp 2\theta)$, the signs being chosen according to the direction of rotation of the wave of magnetism. Thus the E.M.F. induced in the sheath is in the shape of a four-pole rotating wave every bit as much as is the normal induction. If we divide the above expression by ρ, the specific resistance of the sheath, we obtain the value of current density, which is therefore again a rotating wave of current.

These most useful conceptions formed the basis of the theory of the single-phase induction motor published in 1899 above referred to, and are of the greatest aid in the complete comprehension of the present problem.

I hope shortly to publish in full a paper read at Cambridge before the Mathematical and Physical Section of the British Association on August 24th last, in which I gave a full mathematical investigation of the sheath-losses in a three-core cable. I then showed that if we consider a three-phase cable with cores of circular cross-section, fig. 2, where—

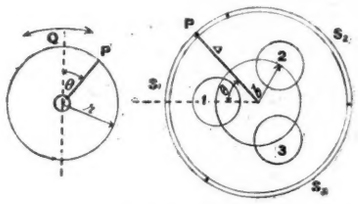
$$\left.\begin{aligned} \text{Current in core 1} &= \text{C} \cos pt \\ \text{,,} \quad \text{,,} \quad 2 &= \text{C} \cos\left(pt - \frac{2\pi}{3}\right) \\ \text{,,} \quad \text{,,} \quad 3 &= \text{C} \cos\left(pt + \frac{2\pi}{3}\right) \end{aligned}\right\}$$

The current being in C.G.S. measure, and k is the number of magnetic lines which thread the rectangular circuit formed by a line of unit length parallel with the axis, and passing through P, a second line of some length along the axis, and two lines at right angles to the axis joining the two first mentioned, then—

$$k = 3\,\text{C}\left\{\frac{b}{\Delta}\cos(pt - \theta) + \frac{b^2}{2\Delta^2}\cos(pt + 2\theta) + \frac{b^4}{4\Delta^4}\cos(pt - 4\theta) + \ldots + \&c.\right\} \quad (1)$$

The terms involving 3 θ, 6 θ, 9 θ, &c., vanishing, and all dimensions being in cms. Further, the normal induction at a point Δ, θ is $\frac{1}{\Delta}\frac{dk}{d\theta}$, or

$$\frac{3\,\text{C}}{\Delta}\left\{\frac{b}{\Delta}\sin(pt - \theta) - \frac{b^2}{\Delta^2}\sin(pt + 2\theta) + \frac{b^4}{\Delta^4}\sin(pt - 4\theta) - \&c.\right\} \quad (2)$$



FIGS. 1 AND 2.

The E.M.F. generated per unit length of sheath at the point Δ, θ is $-\frac{dk}{dt}$, or

$$3\,\text{C}\,p\left\{\frac{b}{\Delta}\sin(pt - \theta) + \frac{b^2}{2\Delta^2}\sin(pt + 2\theta) + \frac{b^4}{4\Delta^4}\sin(pt - 4\theta) \ldots + \&c.\right\} \quad (3)$$

The current at the point Δ, θ is $-\frac{1}{\rho}\cdot\frac{dk}{dt}$. (4)

Where ρ is the specific resistance of the sheath in C.G.S. measure.

The observed torque on the sheath per unit length will be the time-average value of—

$$\frac{1}{\rho}\int_{\Delta_2}^{\Delta_1}\int_0^{2\pi} d\,\Delta\; d\,\theta \text{ dyne cms.} \quad (5)$$

Where Δ_1 and Δ_2 are the external and internal radii of the sheath.

Lastly, the rate of heat production per unit length of sheath expressed in ergs per second will be the time-average value of—

$$\frac{1}{\rho}\int_{\Delta_2}^{\Delta_1}\int_0^{2\pi}\left(\frac{dk}{dt}\right)^2 d\,\Delta\; d\,\theta. \quad (6)$$

Now from the foregoing we see that our normal inductions consist of a number of rotating waves, made up as follows :—

A wave of (say)	positive	amplitude and 2 poles	rotating	C.
,, ,,	positive	,, 4	,,	C C.
,, ,,	positive	,, 8	,,	C.
,, ,,	positive	,, 10	,,	C.C.

and so on.

The waves of E.M.F. and current are exactly similar with the exception that, owing to the change of sign of the coefficients, the alternate ones must be considered as of negative amplitude.

These waves of normal induction produce positive and negative torques, but all give rise to positive eddy current losses. If, for the sake of simplicity, we consider a very thin sheath of thickness τ cms., the torque (5) becomes after integration and simplification—

$$\frac{9\,\text{C}^2 p\,\pi\,\tau\,\Delta}{\rho}\left\{\frac{b^2}{\Delta^2} - \frac{b^4}{2\Delta^4} + \frac{b^8}{4\Delta^8} - \frac{b^{10}}{5\Delta^{10}} + \&c.\right\} \quad (7)$$

While the rate of heat production from (6) becomes—

$$\frac{9\,\text{C}^2 p^2\,\pi\,\tau\,\Delta}{\rho}\left\{\frac{b^2}{\Delta^2} + \frac{b^4}{4\Delta^4} + \frac{b^8}{16\Delta^4} + \frac{b^{10}}{25\Delta^{10}} + \&c.\right\} \quad (8)$$

Now these two expressions are essentially different, and it is quite clear that the loss (8) cannot be derived from the observed torque (7) by multiplying the latter by the angular velocity of the fundamental term, viz., by p.

To obtain (8) from (7) we must remember that the angular velocity of the wave giving rise to the second term in the expression for torque is $-\frac{p}{2}$, that corresponding to

the fourth term is $-\frac{p}{5}$, and so on. Bearing this in mind, we see that (8) is directly deducible from (7) mathematically, but not experimentally.

The complete expression therefore for the sheath loss, if the sheath be thin and cores circular, is—

$$\frac{36\,\pi^3\,C^2\,f^2\,b^2\,\tau}{\rho\,\Delta}\left\{\Sigma\,\frac{1}{n^2}\left(\frac{b}{\Delta}\right)^{2n-2}\right\} \qquad (9)$$

where n has the values 1, 2, 4, 5, 7, 8, &c, successively.

Where the sheath is not very thin (9) must be written in the form—

$$\frac{36\,\tau^3\,C^2\,f^2\,b^2}{\rho\,\Delta}\left\{\log_\epsilon\,\frac{\Delta_1}{\Delta_2}+\Sigma\,\frac{b^{2n-2}}{n^2\,(2\,n-2)}\left(\frac{1}{\Delta_2^{\,2n-2}}-\frac{1}{\Delta_1^{\,2n-2}}\right)\right\} \qquad (10)$$

where n has the same values as before with the exception of the value unity.

Expressions (9) and (10) are rapidly convergent, and for practical purposes the first two terms are usually sufficient.

If the cross-section of the cores be not circular, the coefficients of the various terms of the series are modified somewhat, but, as an approximation to the case experimented upon by Mr. Morris, we may consider the centre of gravity of each core at ·95 cm. from the axis, the inner radius of sheath 2 cms. and outer radius 2·35 cms. (dimensions arrived at by direct measurement of the full-size illustration in the article), then, calculating the true loss by means of (10), we obtain the figure 23·5 watts per mile for a core current of 50 amps. at a frequency of 60. Calculating this, however, on the basis assumed by Mr. Morris, or by multiplying torque by $2\,\pi\,f$, we should obtain 20·2 watts, or a difference of roughly 14 per cent. The figure 20·2 is as near that experimentally determined by Mr. Morris as we could expect, seeing that it is based upon measurements taken from the illustration and upon the assumed figure of 21 microhms for the specific resistance of the sheath material. The coefficients for circular cores have also been employed. Expression (10) shows the actual way the loss depends upon the thickness of the sheath; the formula given by Mr. Morris does not pretend to be other than empirical and approximate. In my British Association paper I investigated the point as to what sizes of cable (10) is still applicable. This expression begins to be inapplicable when the magnetic forces due to the sheath currents are important in comparison with those due to the core currents. I showed, however, that for such small cables as experimented upon by Mr. Morris, this is not the case.

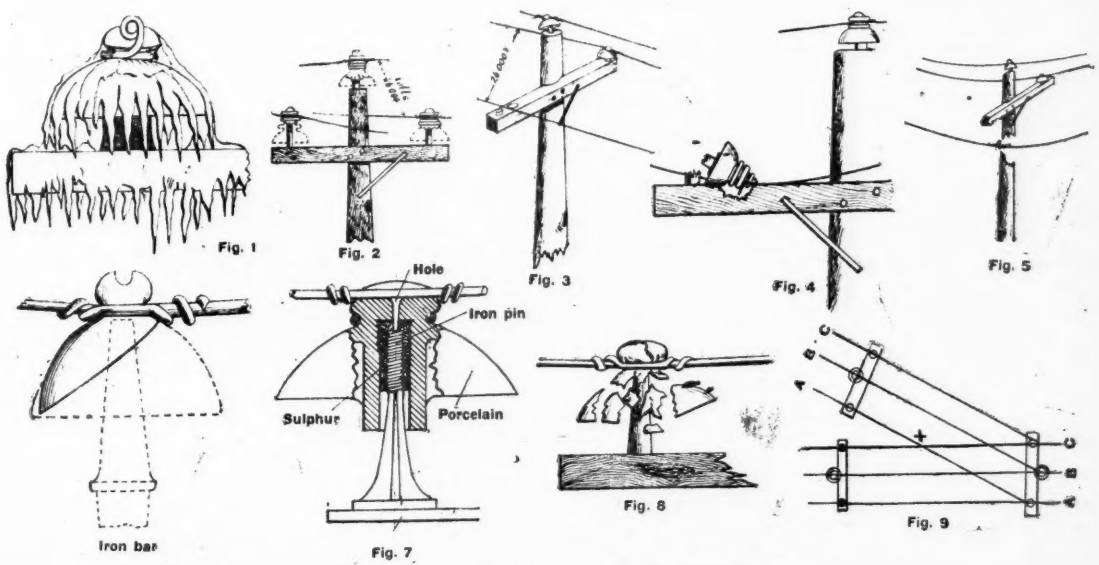
The theory shows that the summation of the various current waves sweeping round in the sheath gives what we may call a *three-phase* eddy current. We can divide the sheath into three segments, s_1, s_2, s_3, fig. 2, and integrate the current density over one segment. Now, although the value and phase of the current density changes from point to point of the sheath, the *total* current in each segment is a sine function in quadrature with the current in the corresponding core. I prefer, therefore, to look at the sheath currents as a three-phase distribution rather than in the manner described by Mr. Morris, who says:—"The eddy currents which are induced in the lead sheath flow up one side of the sheath parallel with the axis of the cable and divide into two streams. They unite again on the opposite side of the sheath and stream down, &c."

The effect of surrounding the sheath with an iron pipe is very interesting. I believe Mr. Morris would have found an increase of considerably more than 70 to 75 per cent. had the pipe more closely fitted the lead sheath. Further, he would probably have found the increase of the lead loss almost independent of the thickness of the iron pipe. Mr. J. F. C Searle has investigated the matter mathematically, and made some interesting remarks at the close of my paper at the British Association. The non-mathematical way of considering this point appears to be thus:—All the magnetic lines generated by the balanced three-phase system pass through the body of the cable, hence the presence of the iron *outside* can only, as it where, short-circuit a portion of their path—*i.e.*, not more than half. The total flux cannot, therefore, be increased by more than 100 per cent., and the losses in the lead increased four-fold. The total flux is, however, so very small that a very thin iron sheath will act as a short-circuiting link for that portion of the field external to the cable.

EXPERIENCES WITH HIGH-PRESSURE TRANSMISSION LINES.

In view of the possible adoption in this country in the future of overhead transmission for high-pressure work, some of the experiences with this class of work in the United States will be interesting and possibly instructive. It has been very truly said that we learn more by our failures than by our successes, and the account of some of the failures in overhead work will serve to show us what to avoid. We are indebted to an article by H. C. Reagan in the *Street Railway Review* for the following information:—

Among the conditions affecting the insulation of a line



Experiences with High-pressure Transmission Lines.

are the elements, climate, quality of insulators, good workmanship, and position. Bearing upon the question of climate, an interesting condition is shown in fig. 1. The ornamentation shown on the insulator and cross arm are due to frost following on heavy rain and fog, the frill-like looking things representing icicles. The line carried a pressure of 26,000 volts, and no trouble was felt on account of the icicles which tends to show that dry ice is a fairly good insulator. The ice was melted off during the night by rain after the current was shut down.

Fig. 2 shows the effect of the opposite condition, namely, extreme heat, this being due to position, and not to climate. This line also carried 26,000 volts, and the pole stood close to the switch tower, which accidently caught fire, setting fire to the pole, causing all the petticoats of the insulator to drop off, leaving only the knobs in position. The insulators were of the Himingray glass type. The nobs, as shown in the illustration, held the line for about two days, and no trouble due to bad insulation was experienced.

Fig. 3 shows how a pressure of 26,000 volts was carried on a bare cross-arm. The line inspector reported that a cross-arm was missing at a point about 30 miles distant from the station, but as no trouble had been experienced, the report was attributed to an oversight. The same report came in about five days later, when it was found on making an inspection that the pin was charred at the top, and that the insulator had burst and fallen entirely out of the tie wire. The fact that no trouble had been experienced was due to the extremely dry season.

Fig. 4 illustrates a condition which resulted in a short circuit on the line pulling out every circuit breaker. In order to locate this fault the sub-stations cut out the line in sections, and then switched on in turn when the whole of the circuit breakers were again thrown out on the last sub-station starting up. The operation was repeated, and everything went well, the fault having burnt itself out. When the faulty insulator was discovered, owing to the pole being somewhat out of line with the others, the inward strain broke the pin, and the insulator turned over without falling off the arm. The tie wire caused a short circuit, burning a hollow place in the arm. When the sub-stations started up the short burned away more of the cross-arm, so cleaning the tie wire and practically removing the leak.

Fig. 5 shows a very extraordinary condition, namely, the top of the pole burned clean in two. The symptoms of the power stations were a heavy short circuit which threw out the whole of the system. The sub-stations were then notified that the current would be put on again, starting with the first station nearest to the power house. On closing the last line switch a short again occurred, but not quite so severe as the first one. The current was switched on a second time, and the circuit breakers kept in. During the night an intermittent short occurred which was not enough to throw out the switches. It appeared, on investigation, that a wire had broken loose from the insulator and burned through the cross-arm. This was probably burned through on one of the occasions when current was switched on from the sub-station. The wind had then caused the wire to swing to and fro against the pole during the night until it was completely severed, as shown in the illustration, the top of the pole and cross-arm being supported by the remaining two wires.

A fault occurring due to defective design of an insulator is shown in fig. 6. It is seen from the dotted lines that the crank stops off short below the groove to which the wires are fixed. This makes a very weak construction; the insulator shown, being on a corner pole and on the inside of the groove, broke clean off and fell almost to the ground with the wire. The symptom at the station was a short circuit throwing out all switches. On closing them again no further trouble occurred, but a report came in that a man had been killed, and it was then found that the wire was lying close to the ground.

Fig. 7 is another instance of a defective insulator, the trouble in this instance being due to a lightning flash. The symptom at the station was a dead short-circuit, but the trouble was very difficult to locate. It will be seen from the illustration that a hole had been punctured underneath the wire, and extending down the shank, the size of the hole being about $\frac{1}{32}$ in. in diameter, but slightly tapering as shown. The hole was as clean as if it had been drilled, and was lined with fused copper run into the glaze. The solder was burned black, forming a direct part to the pin. It was first attempted to locate the trouble by watching the flash when the current was switched on, but this not being very satisfactory, it occurred to the author, Mr. Reagan, that the pins on the defective insulator would be warm, and this proved to be correct, and by feeling the pin for a rise of temperature the punctured one can always be detected.

Fig. 8 shows the troubles that may be anticipated by trying to economise in the cost of insulators. About 50 miles of line were fitted with these insulators, which cost somewhat less than other standard makes. The trouble was due to bad annealing, the effect of which was to cause the insulators to burst with a loud report, with the result that the whole of the 50 miles of line had to be rebuilt with a better quality of insulator.

Fig. 9 illustrates the trouble that is experienced due to contact between cross wires. The line carried 26,000 volts current, and the peculiarity of the short-circuit was that it came on the line about 4.30 p.m. every day, and went off again in the morning when the sun came up. The line was frequently inspected, but the trouble could not be located, and the final solution was due to a small boy, who, in passing the power house, said: "Say, mister, you ought to have seen the fireworks up there last night," and pointed out the position. This point is shown in the figure. The branch circuit is taken off at an angle of about 45°, causing the two outside phases to cross at the point marked +. In the daytime, when the sun was shining, one wire was about 18 in. above the other, but in the afternoon, as the atmosphere grew cooler, the wire contracted until the two came into contact, which was so perfect that very little burning took place, and so made it difficult to detect the fault when the wires were apart in the day.

THE TESTING OF ALTERNATE-CURRENT MACHINERY.

By R. J. KAULA.

(*Paper read before the Students' Section of the Institution of Electrical Engineers, February 17th*, 1904.)

The successful investigations of electrical phenomena which have been made during the last few decades have done much to simplify the accurate testing of electrical machinery. Generally speaking, the tests may be classified under two headings—full load and heating tests, and tests relating to the characteristics of a machine. In the following the writer will endeavour to show how these tests may be best carried out on the various types of alternate-current machinery.

Alternators and Synchronous Motors.

These two classes of machinery being constructed on practically identical lines, they are treated here under one heading.

The first readings taken on all electrical machines should relate to the measurement of resistance of the windings, either on a Wheatstone bridge, or by passing a continuous current through the copper, reading the drop of potential and the current, and obtaining the resistance therefrom. This figure can then be compared with the resistance, as calculated from the winding data.

The next tests to be taken on an alternator are the open and short-circuit characteristics.

The readings required for the former or magnetisation curve are as follows:—The field current, the E.M.F. across the armature terminals, and the speed at which the machine is revolving. The voltage is directly proportional to the speed, and is reduced to normal speed. It is essential that, whilst this curve is being taken upwards the field current should be constantly increased, as, if it were reduced, the magnetic flux would be slightly above that normally produced by the field ampere-turns, owing to remnant magnetism.

The short-circuit characteristics give the armature current as function of the field current, the armature being short-circuited by means of an ammeter. It will not be found necessary to take account of the speed in this case. For three-phase machines the two and three-phase short-circuit characteristics are both of interest. Fig. 1 shows the open and two and three-phase short-circuit characteristics of an 11 K V.A. generator.

To ascertain the reactance of the armature it is advisable to take a curve with relative position of field poles and armature as abscissæ and reactance as ordinates.

Fig. 2 shows such a curve, from which the mean reactance may be determined.

The reactance and resistance of the armature having been ascertained, the induced E.M.F. is found graphically for any load and external power factor.

In most cases the value of E*i* the induced E.M.F. is only required for one given power factor. From the open circuit characteristic

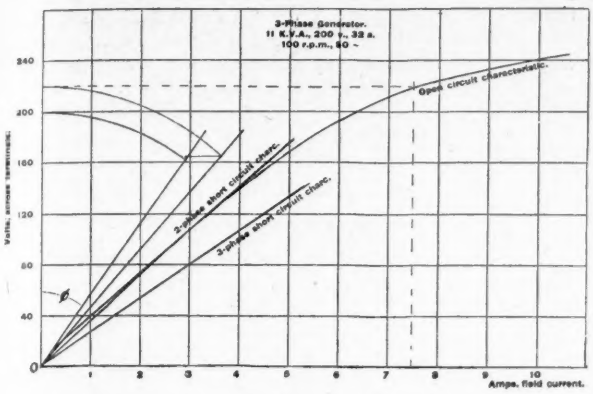


FIG. 1.

the field current is then determined, which is needed to induce E*i*. There remains to be added the field current to counteract the armature reaction, which is found from the formula (Kapp):—

$\mathrm{x}g = q\,c\,\mathrm{K}$ where $\mathrm{x}g$ is found in ampere-turns;

q = number of wires per pole and phase;

c = normal current; and

K = a constant $= n \times \frac{0{\cdot}57}{m} \times \sin \frac{m\pi}{2}$;

n = number of phases;

m = ratio of width of pole to pole-pitch.

There is a great variety of methods for arranging full load or heating tests for alternators, and circumstances dictate which to adopt. The simplest "load" is probably a wooden butt of water, in which metal plates are dipped, which are connected to the machine terminals. For small generators, of comparatively low tension, a liquid resistance, such as is used in the rotor circuit of an induction motor, answers the purpose well, especially for three-phase machines, and it enables the load to be readily varied. The writer has frequently used German silver wire spirals laid under water as load. The resistance of the wire must, of course, be calculated for 100° C. Increasing the load necessitates short-circuiting sections of the

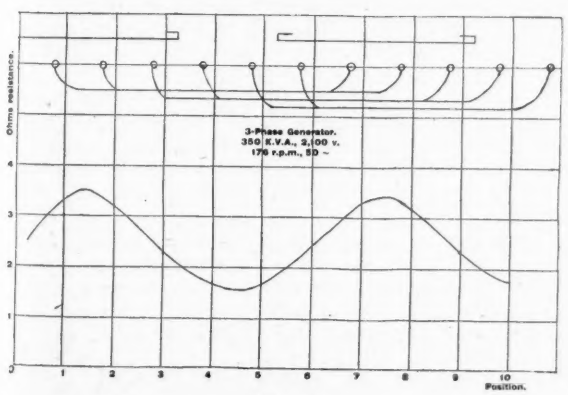


FIG. 2.

spirals. This is a somewhat awkward matter when the temperature of the water = 100° C., and a few lengths of insulated wire soldered to different points on the spirals, and led out of the water, will enable this to be done more simply.

These methods are, however, very wasteful; moreover, a prime mover of sufficient power is not always available. If two generators of the same size can be tested together, the one generator may be connected to, and drive the other as, a synchronous motor. By sufficiently lowering the field current of the latter, a power factor of very near zero may be obtained, and a full load test is thereby arranged with a minimum expenditure of power. After the heating test, the duration of which varies with the size of the machine, the increase of temperature should be read on a thermometer on the armature windings and iron, on the pole-pieces, slip-rings, &c. For the field windings it is best to determine the increase of resistance and calculate the increase of temperature therefrom. For the outer windings, which are the only parts which are accessible with the thermometer, are the best ventilated, and their temperature varies considerably from that of the inner layers.

The most satisfactory way of determining the efficiency is to find the sum of the losses and to take the efficiency as the ratio of output to output + losses. There are four main sources of loss:—Resistance of the field; resistance of the armature; hysteresis and eddy currents; and lastly, friction and windage.

The field current required to give full terminal voltage is found, as described above, from the magnetisation curve for any load, and the excitation losses are equal to the resistance of the heated field winding, multiplied into the square of the current.

The armature resistance loss is determined by multiplying the resistance into the square of the respective current.

If an exciter is direct coupled to the generator, the former can be run as motor off a continuous current supply at full speed, and its output gives the generator's loss due to friction and windage. If

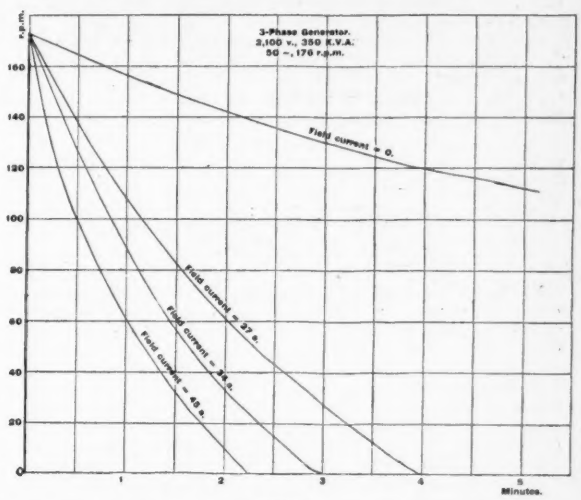


FIG. 3.

the generator field is then supplied with the exciting current reqnired for full terminal voltage at open circuit, the additional output gives the hysteresis and eddy loss for no load. The readings are repeated for several values of the field current correspond-

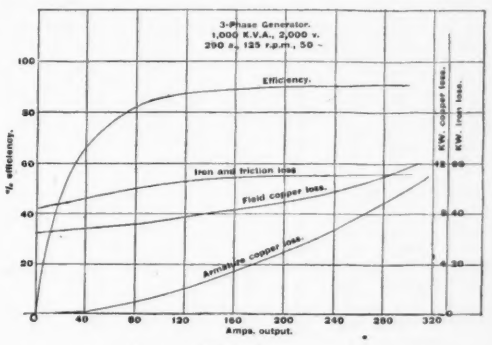


FIG. 4.

ing to the varying value of induced E.M.F., and thus also corresponding to varying load. This method requires an efficiency curve for the exciter, which, however, will probably be needed in any case.

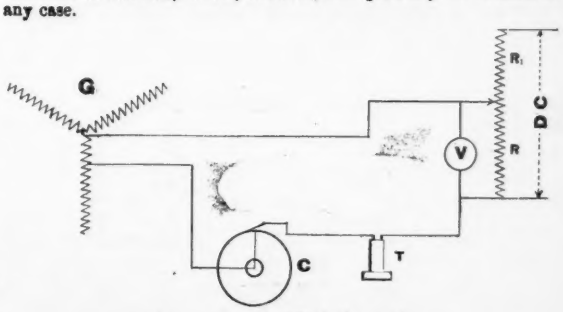


FIG. 5.

For generators with revolving field of the fly-wheel type, the same results may be arrived at by means of retardation curve These are obtained in the following manner:—The machin. brought up to the speed, and the driving belt is then slipped off. The speed is then read on a tachometer and noted down at regular intervals, and a curve is plotted giving the speed as function of the time elapsed, after the belt was removed. Such curves are taken for several values of the field current as shown in fig. 3.

If I = moment of inertia of the field in kgm.^{2}, t = time elapsed between first and second reading, n_1 and n_2 = first and second

tachometer readings respectively; then when the field current = o, the friction losses F, in watts, are found from the formula,

$$F = 1 \times 9{\cdot}8 \times \frac{(n_1^2 - n_2^2)}{2 \times t}.$$

If the field is excited, the machine will, of course, run down in less time, and an increased loss F_1, will be calculated, giving hysteresis and eddy loss in addition to friction loss. Then $F_1 - F$ gives the actual iron loss at that excitation.

Let the generator be driven as a synchronous motor at full speed and no load, the power factor being brought up to approximately unity. The power consumed will again equal the sum of the hysteresis, eddy and friction losses.

According to Steinmetz the eddy current loss is proportional to the square, and the hysteresis loss to the 1·6th power of the induced E.M.F.

If we, therefore, take readings at *three* different impressed E.M.Fs., in each case the formula,

$$W = E^{1\cdot6} K + E^2 K_1 + F,$$

will hold good,

where W = watts consumed;
E = impressed volts;
K = hysteresis loss coefficient, a constant;
K_1 = eddy loss coefficient, also constant;
and F = friction and windage loss.

We have, then, three equations from which the three unknown quantities, K, K_1 and F, are found. Not only do we hereby obtain the no load losses for any given E.M.F., but also a very complete separation of these losses, which in itself is a most important matter.

The only separation which is not obtained by one or other of the aforementioned methods is that of windage and friction, which have been considered together. From the retardation curve I. (with no field current), however, we can find the friction loss for a comparatively low speed where the air resistance is negligible, and if the friction loss be then taken as directly proportioned to the speed, a separation of these two losses is also arrived at. As a matter of fact, it is hardly right to call the power required to overcome windage, a loss. For the power so expended is exceedingly useful for ventilating.

Fig. 4 shows the efficiency curve of a 1,000 K.V.A. three-phase alternator calculated on the above-mentioned lines.

The wave-shape of an alternating E.M.F. is most readily furnished by the oscillograph; but where this instrument is not at hand, the arrangement shown in fig. 5 will be found very convenient, especially as the only instruments required are a telephone and a voltmeter. The resistances R and R_1 are so regulated that the continuous potential difference across R equals the instantaneous value of the alternating E.M.F.

If this is the case, no current will be flowing through the telephone T, and consequently no sound can be heard. The revolving contact maker C is connected up in the usual way.

Rotary Converters.

The efficiency may be easily arrived at by reading watts input and output. The alternating-current side can be tested in the same way as an alternator or synchronous motor, according to which of these two machines it represents. If the latter, it is interesting to determine the power factor with varying continuous-current load, and therefore varying field current.

The efficiency may also be obtained from the losses, which are of the same character as in an alternator. The armature copper loss is not equal to C^2R, if C is the continuous current, and R the armature resistance measured from the continuous current side. The actual loss is equal $C^2R \times K$, where K depends on the power factor and number of phases supplying the machine for a three-phase machine at power factor unity K is about ·53, and for power factor ·8 K will be = ·73.

As rotary converters were dealt with very fully at a recent meeting, it is not proposed to discuss them again more fully in this paper.

(To be continued.)

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week.

Curious Effect on a High Pressure D.C. Generator.

The commutator of a 75-KW. 1,100-volt four-pole D.C. generator was being cleaned, the engine running at about full speed. The generator is separately excited, the two positive brushes are connected together by a lead passing around the rocker; the negative brushes are similarly connected. At the time one of the sets of brushes was lifted off the commutator, it was observed that the other brushes sparked violently. I examined the generator, and found that there was no field current on, and that the field switch was open at the time; yet it was possible, by lifting the one pair of brushes and advancing the brush rocker by $\frac{3}{4}$ in., to cause the other brushes to spark badly. I measured the volts at that point, and found that 60 to 70 volts pressure was generated in about 15 seconds after lifting the one set of brushes. Observation was not continued further, on account of the sparking. When the brushes were in the proper position for no load, no such effect was observed, although about 3 volts was generated, owing to residual magnetism.

G. H. P. Morgan.

Barrow-in-Furness,
September 18th, 1904.

Studying the Consumer.

Your leader on "Studying the Consumer" commends a subject that might be very well carried further, as it is a matter of increasing importance with growing competition.

The office methods mentioned and developments are doubtless the best means of attacking the problem, but if the experience of numerous station engineers could be gathered into a general fund of information, the labours of the "research" would be greatly facilitated.

If one sets to work to seriously consider the petty annoyances to which a consumer may be subjected the matter assumes quite a grave aspect.

The question of fuses is always a plentiful source of trouble, and not infrequently switches fail to make contact. The impression is so strong that things go wrong generally, that the writer has known numerous cases of consumers sending down to the works in a high state of agitation or in a worse state of supernatural calm, to say that they have no light, without taking the trouble to see if the main switch is turned "on."

These cases of minor interruptions will go a long way towards destroying a reputation for general reliability if they are not systematically hunted down.

One gets too much into the habit of thinking that because a circuit is "protected" by a fuse, it will look after itself. As an example, one of the commonest sources of trouble is the twisting round of a lampholder on a fitting when cleaning it or a shade. This could be avoided by means of a set screw, or, better still, a touch of solder, as so many otherwise serviceable fittings have not metal enough in them to take a reliable set screw. With regard to fuses, they are too frequently made with absurd little screws with only a couple of threads to hold into a soft brass stamping. With alternating currents such screws will work loose very easily, and there is always a good chance of the screw falling out and getting lost when it is necessary to put in a new fuse, working by the light of a candle on the top of a pair of steps.

The things may not be directly under the control of the supply station, but it is common enough to state that "switch-holders" must not be used without samples being approved, and it is usually done without any trouble. A little pamphlet of hints on wiring, &c., might be sent to each consumer with his application form.

Another cause of vexation is meters stopping or getting out of order. Some of this trouble might be overcome by studying more closely the conditions under which the meters have to work. As examples of conditions, one might mention vibration from traffic or neighbouring machinery, excessive dust, unusual temperature, or subject to momentary overloads in the case of motors and arc lamps. Even at the expense of the consumer, observations on the behaviour of different types of meters might lead one to more judicious selections in the future.

With reference to "elaborate" methods of charging, we are only waiting for a happy means of making the system understood. Nobody complains that a printer is faddy and ridiculous because his charges are so variable. It is understood that the preparation expenses of setting up type, &c., are heavy, and that the actual printing is cheap. The printer's client, however, is able to say how many copies he wants. A quotation from a printer at so much for the first 100, and so much for every additional 100, would be accepted as straightforward and reasonable. We have only got to present our case to consumers in a similar light; so much to provide the means of supplying, and so much to continue

doing so. The meter records the equivalent of so many sq. ft. of printing, the demand indicator shows us how many sq. ft. per copy, we sell the first 100 for so much, or so much each, and all after at a lower rate. We make a new contract every half-year or quarter. Why should the consumer be mystified?

There is just one other point. Suppose that the printer's client was not able to say what size his circular would be, that he might want to vary the size, would it be unreasonable for the printer to say, "Under these conditions I must charge you at the rate of the largest one required; you see that I shall have to set up the type for the largest, and it makes practically no difference to me whether I print from the whole, as set up, or a part." Well, we must argue on similar lines, and base our charges accordingly. But we go one better, we say that you may add the smaller ones together, and we will charge you for the equivalent number of the largest.

The consumer has only to understand that our costs of production are similar to a printer's, in order to see the reasonableness of the charges, and he will soon learn how we arrive at our statement from the two measurements which he can take himself at any time.

After all, with these elaborate methods of charging, we *do* study the consumer very closely, and charge him the lowest possible price that the conditions of his supply permit.

It is much to be regretted that accountants and other capable men are too apt to express opinions on this subject without giving it their best attention. On the other hand, it is likely enough that the engineers of the past have been a little too casual in matters of finance to command the attention that such a development may deserve.

In "Studying the Consumer," we may arrive at a better understanding, but I really do not think that station managers use their Parliamentary powers in any more aggressive spirit than the ordinary business man when he is obliged to avail himself of the protection afforded by commercial law.

J. Rutherford Blaikie.

Streatham Hill, *September 19th*, 1904.

Value of Education.

Without wishing in the least to contradict "University Lecturer's" views as expressed in the current issue of the Electrical Review, or to minimise the value of the "money value of education" curves of the American Institution, published a week ago, yet there is an old English saying to the effect that "there are three generations between porridge and porridge." This has probably some truth in it, and likely enough is founded on observation extending over many centuries. Perhaps there is a natural law, like the convection currents in heating water?

Does not also Andrew Carnegie tell us in his "Empire of Business" that the less start a man gets in life the better for him? Yet his actions contradict this and favour education.

As a lecturer in a London Polytechnic I have seen men physically quite unfit turn out four or five nights a week to attend classes. These resemble A's case probably. Further, London University puts a premium on this sort of thing by offering a degree to candidates attending a course of evening lectures. At the same time I think they ought to organise a pension scheme to assist those who break down under this ordeal.

Yet Mr. Jacks, LL.D., an ironmaster, says all his success is due to education, and states that he studied nightly theology, mathematics, and four or five languages. He omits to state, however, whether he attempted to pass exams. in these subjects, which is, of course, a different affair.

Personally, after doing a hard day's work, I could not, with profit to myself, attend evening classes for more than, say, two nights a week.

Again, Sir William Ramsay, referring to British manufacturers, is reported to have said "that we are more scientific than the Americans, but less so than the Germans," *e.g.*, a B.Sc. degree here should have a greater value than in America, but less than in Germany. My experience of Britain and Germany does not tend to confirm this.

Perhaps some others interested can throw some light on this question. To me it appears that if a man has a *very exceptional* scientific training, he may get a situation at £200 a year in a works; for an ordinary graduate there is no demand, and the degree has very little, or no, money value.

Sir William Arrol has also stated that he has tried D.Sc.'s and graduates in his works, and apparently does not believe in scientific training, for his class of work at any rate. And Sir William is a good type of the successful engineer in this country.

Graduate.

September 19th, 1904.

Unfair Competition.

I have read the letter of "Educated Mechanic" and Mr. Geo. Barham with interest, and can endorse the former's remarks. Like him, I am unfortunate enough to have been out three weeks, and am rather an exception in this country —that is, a book-keeper (vulgarly known as "clurk"), with commercial and technical education, holding London Chamber of Commerce certificate (senior) for book-keeping, and also certificate for workshop practice from a technical institute. In spite of stating these qualifications when answering advertisements, my letters receive as good an answer as if I stamped and threw them into the street. I have only had to leave places through sheer misfortune, being very lucky in getting into those that go on for a while and then dissolve into water.

I do not answer advertisements like Mr. Barham suggests, but always ask them to favour me with an interview if my application is successful; and if these delusions do not answer after three days, I know my letter has been deposited in the W.P.B.

Again, the advertisers are very much to blame, as some of them are most vague, and others do not ask for references, but merely say "state age and salary expected." In Germany, clerks are first given a certain time in the shops, and then in the office, and just lately I have had three years in a small shop, besides being in the office and stores.

Is technical and commercial education really wanted in this country, and is not the tendency to pay as little as possible to the clerical staff? In America and France book-keeping is far more thought of than here, especially in the former country, and the books in this country are generally considered of the least importance in running businesses. One has only to look through the various trade failures, which will confirm my statement.

Disgusted Technic.

Mr. Barham's letter refers to wiremen, engineers and jointers. Before I reply to that gentleman's letter, will he kindly see his way clear to state what rate of wage wireman he refers to? also is it an electrical engineer? and last, but not least, a cable jointer that is used to all classes of cable?

If Mr. Barham will not think it tedious to read and reply, I will be grateful.

Reader.

"H. J. S.," Chatham.—The Wireman's Examination is held not in London alone, but in local centres wherever the Preliminary Examination in Electric Lighting is held. The Wireman's Examination is open to those who have passed the former in the same year, and is concluded in one evening. Full particulars can be had from the City and Guilds of London Institute, Gresham College, London, E.C.

Information Wanted.—A correspondent asks whether the Kohinor Lamp Co. is still in existence.—Eds. E.R.

THE LESLIE WALKER INSTANTANEOUS FIRE DETECTOR.

We have had introduced to our notice an exceedingly simple protective device against fire, which the makers claim to be thoroughly reliable, and capable of meeting the diverse conditions of situation and temperature variation, to which such devices are subject.

The fire detector consists of a glass tube (see figs. 1 and 2) charged with mercury and with the air exhausted, so that a vacuum exists in those portions of the tube not occupied by mercury. This entirely prevents oxidisation or other interference with the contents.

The tube is arranged with a long bulb portion containing the mercury, connected at one end to a compensating chamber, through

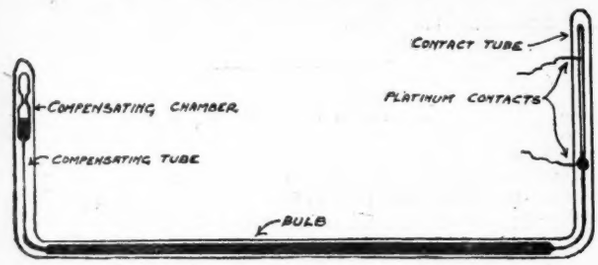


Fig. 1.—Diagram showing Mercury Tube.

a compensating tube, and at the other end terminating in a contact tube containing two platinum contacts. The lower contact is immersed in the mercury, and the upper one, under ordinary circumstances, is a short distance above its level in the contact tube.

This apparatus is enclosed in a suitable case for fixing to the ceiling, the contacts and section of tube between them forming part of an alarm-bell circuit, combined, if necessary, with an indicator board, where many apartments are protected.

In operation, during normal rises of temperature caused by atmospheric changes, the lighting of gas-jets, stoves or fires, &c., the mercury in expanding flows up the compensating tube into the chamber above, surface tension preventing its rise in the contact tube. In the event of an abnormal rise of temperature, the restricted section of the compensating tube prevents all the expanding mercury from passing up the latter, and a portion of it is immediately forced up the contact tube, closing the bell circuit by connecting the platinum contacts.

In the case of a smouldering fire, where the rate of increase of temperature would probably be normal, the mercury flows into the compensating chamber until the latter is full, when it is forced up the contact tube, giving an alarm. This chamber fills at 150° F., or other pre-arranged temperature; the compensating tubes are varied in size, so as to withstand any rate of increase, so that any conditions, no matter what the normal rate of increase may be, can be satisfactorily dealt with. Accidental breakage of the tube would result in the mercury being immediately forced up into the vacuum existing in the contact tube, and so giving an instant alarm.

Before putting in a detector, tests are made, and the normal rate of increase per minute determined; a detector which will withstand about four times this amount is selected, so that a considerable factor of safety is left, and the occurrence of false alarms is avoided.

Before leaving the makers, these instruments are numbered and tested, records being kept of the respective rates of increase in degrees per minute, to a tenth of a degree, that they will withstand.

Several of these installations have been satisfactorily working for some 8 to 10 months past, test installations having been put up in America and on the Continent. At a recent demonstration in the Essex Hall, which has an area of some 2,000 sq. ft. and contents of upwards of 50,000 cb. ft., a detector fitted in the dome of the building, 46 ft. above floor level, gave an alarm within 10 seconds of the burning of a newspaper in the hall, and we can vouch for similar results in the case of offices similarly fitted and tested, and at the company's headquarters, 34, Hatton Garden.

Several well-known authorities have reported favourably on the device, and its exceptional features will, no doubt, receive due recognition in the near future.

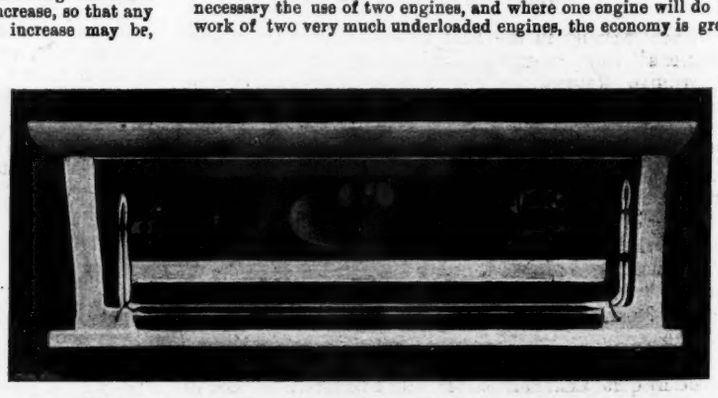


Fig. 2.—Fire Detector, Side Panel Removed.

THE ECONOMICAL EFFECT OF GOOD VACUUM.

In his paper read before the Institution of Mechanical Engineers some two years ago on tests with the engines at the Durham College of Science, Prof. Weighton dealt especially with the question of the economy of vacuum. As this question has come so much to the front of late, it may be worth while looking back at the paper mentioned.

The test engine, it may be remembered, is capable of a good deal of variation in its arrangements. In this particular engine the arrangements were made for triple expansion with 7-in., 10½-in., and 15½-in. cylinders, a boiler pressure of 150 lbs. and a cut-off in each cylinder at 10½ in. of the 18-in. stroke. The engine ran on a brake, and all speed variation was, therefore, due to variation of vacuum, the brake being unchanged. In getting out results, all figures were reduced to a basis of 120 revolutions per minute.

The best results in steam per horse-power-hour, both indicated and brake, were obtained at 26 to 28 in. of vacuum, but, with a vacuum of 20 in., only the benefit of hotter feed over-balanced the loss due to the poor vacuum. We are thus called on by the Professor to agree to vacua of 20 in., but we by no means agree with his reasoning, because there are so many losses of heat about a steam plant, that if one source of feed heating be employed, another must be rejected, and we cannot do the things that we would, for our total waste heat is so many times the amount of heat utilised.

The Professor finds that the cooling effect of good vacuum extends right through the engine to the first cylinder, and this admits more steam per stroke with a high vacuum than with a low one. The mechanical efficiency of the engine appears unaffected. A 20-in. vacuum more or less, according to the engine, is recommended, the higher vacua to go with the greater number of cylinders.

Nine trials were made in all, with vacua from 0 to 28·18 in. of mercury.

The figures and diagrams are useful if not unthinkingly employed. We would not stickle for excessive vacuum at the expense of too much cooling water, or at the expense of too high an air-pump speed. What we do like to see is the power to obtain a vacuum of, say, 14 lbs. that will not fall below 12 lbs. if the engine be left standing an hour. Then, if these results can be got by proper attention, one would say, cut down the water supply and reduce the air-pump speed until the vacuum is as poor as is desirable, remembering that a few degrees saved at the hotwell feed supply may, after all, be of less account than the Professor assigns to them.

But our experience is that a poor vacuum usually accompanies an excessive water supply and an altogether unnecessary air-pump velocity. This is the mischief of the separate or independent condensing plant, that it gives the young engineer the power to improve the vacuum by excessive air-pump action, to the neglect of careless leaks of air that would very soon call for remedy if the air pump only ran stroke for stroke with the engine it serves. These independent condensing plants are somewhat of an exotic and are responsible, in a sense, for much careless steam-plant handling. Rather than seek for bad joints in exhaust and injection pipes, one finds over-driven air pumps, and almost cold hotwell discharge, both the immediate result of bad maintenance.

The paper shows that a 26-in. vacuum was accompanied by a B.H.P. of 71·1, as against only 66·9 for a vacuum of 20·4 in., so that it might easily happen that the better vacuum would render unnecessary the use of two engines, and where one engine will do the work of two very much underloaded engines, the economy is great. We admit this is incidental only, but it is not unknown. We have before us an example where something of the sort might easily occur.

A steam plant must be taken as a whole, and the cases would probably be few where any economy resulted from reducing a good 26-in. vacuum to 20 in. Alone the engine might show better results if credited with the heat it regained from the hotwell. But in the coal bill, we think the reverse would be usually exhibited, and even if there is not much to be saved by a high vacuum, there is a certain moral value in it which is a satisfaction to a decent engine-room staff, for it is an indication of their ability and fitness for their work, and we should generally expect to find the best vacuum where the engine room was the tidiest and cleanest.

The Cable Conference.—It is reported that Sir Sandford Fleming will represent Canada at the Cable Conference, which is to be held in London in November.

BUSINESS NOTES.

Electrical Wares Exported.

Week ending September 22nd, 1903.		Week ending September 20th, 1904	
Alexandria	Value £78	Alexandria	Value £76
Amsterdam	100	Amsterdam	25
Antwerp	35	Auckland, Elec. trams.. ..	3,000
Auckland	181	Bangkok	45
Bangkok	141	Bombay	2,578
Buenos Ayres. Teleg. mat. ..	240	Calcutta	215
,, ,, Teleph. cable..	180	,, Elec. machinery ..	6
Calcutta	494	Cape Town. Cable	2,132
,, Teleg. wire	1,350	,, Teleg. mat. ..	2,113
Cape Town	318	Christiania	19
Colombo	23	Colombo. Elec. machinery ..	60
Durban	1,208	,, Teleg. mat.	53
,, Electric cable	1,473	Copenhagen	18
East London	75	Delagoa Bay	87
Fremantle	23	Durban	1,214
Hamburg	25	,, Teleg. mat.	370
,, Teleg. mat.	355	East London	15
Hobart	85	Fremantle	146
Hong Kong	25	Gibraltar. Elec. machinery ..	32
Malta. Teleg. instruments ..	140	Hamburg.	28
Melbourne	200	Hong Kong	164
Montreal	177	Karache. Elec. cable	53
Oporto. Elec. cable	725	Madras	71
,, Teleph. mat.	45	,, Elec. machinery ..	86
Perth	37	Malta..	26
Port Elizabeth	470	Melbourne	266
Rangoon	18	,, Teleg. mat.	20
Rosario	99	Montreal	37
Rotterdam	15	Nagasaki. Elec. machinery ..	374
,, Teleg. wire	12	,, Elec. cable	131
St. John's, N.F.	52	Ostend	50
St. Petersburg	300	,, Elec. instruments ..	30
Shanghai	52	Penang	140
Singapore	320	Port Elizabeth	20
Spegia	363	Rio Janeiro. Teleg. mat. ..	135
Stockholm	33	Rotterdam	218
,, Teleg. wire	32	,, Teleg. wire	13
Suez	10	Rouen	18
Sydney	529	St. Lucia	35
,, Elec. cable	2,980	Saigon	44
		Shanghai	120
		Singapore	55
		,, Elec. cable	1,320
		,, Teleg. mat.	10
		Sydney	216
		,, Elec. traction cable ..	2,900
		Trinidad	26
		Vera Cruz	10
Total £12,958		Total .. £18,750	

Foreign Goods Transhipped.

Barbadoes. Teleph mat.	Value £24	Calcutta Elec. goods ..	Value £14
Madras. Elec. appar.	11	Durban. Elec. goods	83
Melbourne. Elec. appar. ..	19	Sydney. Elec. lamps	25
Sydney. Elec. lamps	300	Wellington. Elec. goods ..	61
Total .. £354		Total .. £133	

Educational Notices.—We have received from Dr. R. Mullineux Walmsley, principal of the Northampton Institute, Clerkenwell, a copy of the announcements of classes, &c., for the 1904-5 Session. The day classes in Mechanical and Electrical engineering, extending over four years, are referred to in detail. The evening classes in Electrical Engineering have been remodelled, and the complete course now covers five years. In the Mechanical Engineering Section, full evening courses for automobiles, their design, construction and working have been arranged, and the courses in Structural Engineering have been remodelled. The syllabus, which consists of some 260 odd pages, contains, as usual, photographs of various departments. Intending students in Electrical and Mechanical Engineering should hasten to see this publication, as the *evening* courses and classes in those sections will begin on Monday next, the 26th inst., and the *day* courses in Engineering start on Monday, October 3rd.

The Birkbeck College, which has now completed 81 years of educational work in the metropolis, commences the new session on Monday, October 3rd, when Dr. J. E. Mackenzie will give the opening address at 7.30 p.m. The College has added considerably to its appliances in recent years, and the physical, chemical, biological, and metallurgical laboratories are well equipped.

Prof. A. Jamieson, M.Inst.C.E., of Kelvinside, Glasgow, has sent us particulars of his courses of tuition in electrical and mechanical engineering by correspondence; students are prepared for examinations and situations by this means.

Exports of Electrical Machinery.—A slight increase is noticeable in the exportation of electrical machinery from this country, the shipments during August last being returned at £42,380, bringing up the total for the first eight months of the year to £306,729, as compared with £295,853 in the corresponding period of 1903.

Calcium Carbide Manufacture in Ireland.—Some works for the manufacture of calcium carbide have been established at Askeaton, Co. Limerick (a town which, by the way, the Limerick press describes as having gone to the dogs). A mill on the River Deel has been rebuilt, and the water power of the river is utilised to drive a 300-H.P. turbine which has been installed, and which is connected by belt to a generator of 3,000 amperes capacity at 100 volts, running at 480 r.p.m. Two electric furnaces of the "Bastick" improved type have been erected. Raw material is stated to be very plentiful in the neighbourhood, and is found at an average depth of 6 in. from the surface. Kilns have been erected adjoining the mill for roasting the limestone. The works are situated on a site of about 30 acres. Mr. Joseph Bastick, late of Liverpool, designed the whole of the scheme and supervised the erection of the plant for Messrs. Hewson & Co., the proprietors, who have, on the completion of the work, retained him as their resident consulting engineer. Amongst other work carried out by Mr. Bastick is a water-power plant at Settle, steam plant at Chatburn, Lancashire, steam plant for the Birmingham Carbide Co., Ltd., and a gas plant for the United Alkali Co., Ltd., of Widnes.

Catalogues and Lists.—A very full catalogue of electric heating and cooking apparatus has been issued by the British Prometheus Company, Ltd., of Kingston-on-Thames. There are about 400 different patterns listed, the new designs including highly-finished hand-beaten copper jugs, antique copper jugs, brass kettles, kettle-stands in wrought-iron, polished brass, oxidised silver, new copper, nickel plated and silver plated kettles, egg-boilers, vegetable dishes, food warmers, bath heaters, immersion heaters, bed warmers, sterilising apparatus, drying ovens, soldering irons, and a variety of other things of a like nature. The restaurant section comprises every article necessary for high-class buffets and hotels, and certainly is a most complete list which should be useful to caterers. In the flat-iron section, the construction of the various articles is gone into in detail, and over 20 different patterns of irons are listed suitable for dry cleaners, laundries, clothing factories and general domestic purposes; flat-irons are also included, and also ironing machines. The convector section is very complete, 35 different types appearing, the particular features

Fig. 1.

Fig. 2.

Fig. 5.

Fig. 3.

Fig. 4.

Prometheus Electric Heating and Cooking Apparatus.

and advantages of "Prometheus" goods being stated. Fig. 1 shows an illuminated convector which is made in hand-beaten copper, and is very suitable for entrance halls and rooms with dark oak panellings; it is made in another style of similar construction, but in armoured iron. Fig. 2 shows one of the many forms of soldering irons. Fig. 3 illustrates a serviceable 1½-pint brass kettle which takes 9 minutes to raise 1 pint of water from 60° F. to boiling-point. A Jersey can in brass appears in fig. 4. The other device shown (fig. 5) is a flat-iron for domestic use, weighing 2 lbs., and consuming only 120 watts. The British Prometheus Co. have recently extended their premises, and among the advantages thus obtained will be the ability to give prompter delivery.

The Cambridge Scientific Instrument Co., Ltd., has issued a new and revised catalogue (No. 25) of instruments for Technical Thermometry, describing electrical resistance thermometers, thermo-electric thermometers, continuous temperature recorders, electrical resistance furnaces, &c. The information is clearly set out, prices, code words, and a number of sectional drawings and curves appearing. A loose list which accompanies the catalogue gives the names of some of the users of the Cambridge Co.'s electrical instruments. This list reminds one of the importance of the subject of temperature in many of our industries, and the names given are a proof that progressive firms are giving the subject their attention. The Cambridge Co. will send a copy of the list to anyone applying to them at their works, Carlyle Road, Cambridge.

Messrs. W. C. Yuille & Co., of Tradeston, Glasgow, are sending out circulars relating to their "Tetrad" trolley ears, which dispense with the use of solder; it is claimed that trolley wire suspended by the "Tetrad" ears will outwear three renewals of wire suspended by soldered ears.

We have received a copy of a new catalogue issued by the Sunbeam Lamp Co., Ltd., of Gateshead-on-Tyne. It is divided into two sections, "A" giving illustrations of new types of lamps, and reduction of prices of old ones; high and low voltage incandescent lamps of various shapes and styles are shown, also high c.p. lamps. Section "B" is devoted to some serviceable and regular lines of electric light fittings and accessories, such as lampholders, tumbler switches, cut-outs, ceiling roses, fuseboards, ball fittings, iron shades, wall plugs, ironclad switches, &c. The works were recently extended in order to cope with the increased demand for Sunbeam lamps. The company will forward copies of the catalogue on receipt of application.

Concert.—To-morrow, Saturday evening, a concert is to be given by the Robertson Electric Lamp Makers' Football Club, in the dining hall of Brook Green Works. The concert commences at 7.30 p.m., and Mr. C. Wilson is to take the chair.

Power Plant for Oil Works.—The British Electric Plant Co., Ltd., of Alloa, have been awarded the contract for three electric generators of 250 h.p. each, for Messrs. James Ross & Co., of Philpstoun oil works.

Workmen's Compensation Case.—Messrs. R. W. Blackwell & Co., the contractors to the Lancaster electric tramway extension, were the respondents in a workmen's compensation case at Lancaster County Court on Friday, in which the plaintiff was Alfred Norman, a labourer belonging to Lancaster. The facts showed that Norman had only been employed for 10 days, at 5d. per hour, when he met with the accident. He had been sent to the goods station of the London and North-Western Railway to unload the arms for the overhead wires, and found the work of getting them out of the wagon too much for one man. He applied for another, and was told one would be sent. While at work he felt his back crack and fell unconscious. He was taken to Lancaster Infirmary, and was under treatment for strained muscles of the back from July 20th to August 9th. Finding himself unfit for work, he claimed 12s. 7½d. per week compensation for permanent disablement. His Honour, after hearing the evidence, said, *prima facie*, there was no case, because the accident must be on the works of the employer in order to make him liable. Dr. Muckalt contended that the works of the "undertaker" were the streets and the station, to which the materials for doing the work came. The employers were joint occupiers *pro. tem.* His Honour failed to see how a goods station could be called the works of the employer. Dr. Muckalt quoted the case of a bargeman drowned in his employer's dock, but his Honour said there was a material difference, the dock belonged to the employer. Mr. Peace replied with references to "Francis *v.* Turner," and "Wright *v.* Whitaker," and his Honour said the case could not be argued; a man injured while at work in a railway station, unless he was in the employ of the railway company, did not come within the four corners of the Act. There was no case, however hard it might be.

British Trade Abroad.—In the course of a lengthy letter on "German Trade Expansion and British Consuls," "Anglo-Italian" writing to the *Times* from Florence, makes a comparison of German and British Consuls. He says:—"The German Consul can tell you pretty well everything that can be known about German products and manufacturers, from the electric conductivity of a particular wire made in Berlin to the analysis of Westphalian coke. For trade purposes there is no comparison between such a man and the average British Consul. The latter is almost invariably courteous, obliging, well educated, and, in fact, a gentleman, but he is the very last man to be mixed up in trade. If he is not a retired Army officer, he is a civilian without any commercial training, and he must necessarily be left hopelessly behind in a race for trade with his German *confrère*."

A report by the British Consul at Riga goes to show that there at any rate, we stand very well indeed in competition with the Germans. Mr. Woodhouse says that the United Kingdom's proportion of the import trade into Riga "had increased from 37·8 per cent. of the whole in 1898, to 55·7 in 1902, while Germany's share, in spite of all the efforts of her merchants, had fallen from 33·2 to 27·9 per cent. in the same period. The British Isles hold the first place in inports and exports, the latter amounting to £4,622,000 out of a total of just under 10 millions sterling."

Installation Contracts.—Messrs. Duncan Watson and Co., have secured the contract for the electric light installation at Holloway Prison. The whole of the work is being carried out in steel barrel, efficiently earthed, and with a complete system of underground concentric armoured cables between the various buildings. The current is taken from the Islington Vestry at 200 volts, and on the premises it is transformed down to 50 volts for the safety of the inmates. The same firm has also secured the order for the equipment of two complete factories for Messrs. Du Bois, Ltd., one at Salford and the other at King's Cross. The contract comprises over 20 motors (from 25 h.p.), about 50 arc lamps, and considerably over 100 incandescent lights. The work is being carried out to the new Institution Rules. Messrs. Duncan Watson also have in course of completion several large installations, amongst which are: Park Chapel, Crouch End, and St. Saviour's Presbytery, Chiswick.

Oil Separators.—Among a large number of contracts at present in the hands of Baker's Patent Appliances Co., Ltd., of Scarborough, for oil separators, is an order for eight separators for the London County Council, each for 37,000 lbs. of steam per hour (ordered per Messrs. John Musgrave & Sons, of Bolton); also the following:—Two separators for Bradford Corporation, each for about 30,000 lbs. of steam per hour; one separator for Johannesburg, for 13,500 lbs. of steam per hour; one separator for Hong Kong, for 7,000 lbs. of steam per hour. All the foregoing were ordered by Messrs. Musgrave & Sons. The firm is also engaged upon two oil separators for the Central London Railway, each for 80,000 lbs. of steam per hour, ordered per Messrs. Cole, Marchent and Morley; one separator for East London Harbour Electricity Works, for 27,000 lbs. of steam per hour, per the Allgemeine Elektricitäts Gesellschaft; one oil separator, for 7,500 lbs. of steam per hour, for Messrs. Hick, Hargreaves & Co.; two separators for Hornsey Electricity Works, per Messrs. John Spencer, Ltd., of Wednesbury; one separator for 1,600 lbs. of steam per hour, for Messrs. Tangyes, Ltd., Birmingham; and many others for colliery and other use.

Maund v. Loughlin.—At the Manchester County Court, on 16th inst., Albert Maund, electrical contractor, Corporation Street, Southport, sued J. A. Loughlin, mechanical engineer, Mount Broughton, Higher Broughton, Manchester, for £41 11s. 10d., for fixing apparatus for a safety device on the overhead trolley system at Oldham. There was a counter-claim for £41 17s. on the allegation of unskilful work. Defendant, the assignee of a patent for a safety device, approached the Oldham Corporation in 1902, and arranged that half a mile of the tramway system should be fitted with the device. It was arranged that the plaintiff should supply the apparatus, which served the double purpose of intercepting any falling telephonic or telegraphic wires, and in the case of a breakage of the trolley wire, carried the current to earth. Plaintiff was to be paid by defendant for the cost of the materials and working expenses, and also 15 per cent. of the profits. The trial was not successful, owing to the fact that insulators had not been fixed between the guard wire and the bracket supporting it, but plaintiff contended he was not responsible for the omission. His Honour Judge Parry, looking through the correspondence, found that the defendant had repeatedly pressed for payment of the account, and after two years suggested that he had a counter-claim. The whole work was of an experimental character, and everybody was wise after the event. It was not the fault of the plaintiff if the scheme was not successful. He was of opinion that defendant was liable to pay the plaintiff for the work done, and he found for the plaintiff, with costs, and dismissed the defendant's counter-claim.

Trade Announcements.—Messrs. Cecil Hodges & Co., of Finsbury Pavement, E.C., have appointed Messrs. W. G. Morrison & Co., of 59, St. Vincent Street, Glasgow, as their sole agents for Scotland; Mr. James Gray, of Glasgow, no longer represents them for that district. Messrs. Hodges are just issuing a new catalogue, fully illustrating and describing their various types of instruments, switches, &c.

The London Electric Wire Co., Ltd., have appointed Mr. David Alexander, 43, Mains Street, Waterloo Street, Glasgow, as their representative for Scotland. The company has just issued a revised price list of flexible cords, and flexible cables for dynamo and motor connections.

Messrs. F. A. Glover & Co., Ltd., electrical and mechanical engineers, owing to increased business, are, on September 24th, removing to Vine Street, E.C. (off Rosebery Avenue).

Strike.—A strike is in progress of 250 men employed at Messrs. Graham, Morton & Co.'s engineering works at Leeds. The cause of the trouble seems to be the engagement by the firm of a non-union man. The firm absolutely insists on having a mixed shop the same as other large boiler shops in Leeds, and is engaging men to fill the vacant places. Mr. Graham "reserves the right to maintain his own business without any interference on the part of the men," and in this attitude he has our entire support, and the sympathy of all who are concerned with the best interests of manufacturing in this country.

For Sale.—The G.P.O. is inviting tenders for the purchase of old Post Office stores.

The Leicester Corporation invites offers for about 900 yards of temporary tramway track. See our advertisements to-day.

Bankruptcy Proceedings.—At the Leeds Bankruptcy Court, on the 12th inst., the case of J. W. Hunter and A. Clapham, trading as "The Yorkshire Motor Car and Electric Engineering Co," again came forward. The liabilities were £3,415 0s. 1d., the deficiency being £1,367 14s. 8d. Bankrupts commenced business in January as electrical engineers and motor-car dealers. Clapham was an electrical engineer's manager, but it was not stated what Hunter's occupation was. Clapham alleged that Hunter had absconded with goods and money. Under these circumstances the examination was adjourned *sine die*.

Liquidations.—The following letter has been received regarding a note which appeared on p. 457 of our last issue:—

> We notice a paragraph in "Business Notes" in the Electrical Review that the Crypto Works Co., Ltd., has resolved to wind up voluntarily, and should be glad if you would inform your readers that this company has no connection whatever with the Crypto Electrical Co., as the electrical department was bought and transferred to 3, Tyers Gateway several months ago,
>
> The Crypto Electrical Co.,
> Cecil R. Shaw.

Under the compulsory winding-up order, made last March, against the Electric Timber Seasoning and Preservation Co., Ltd., Mr. H. Brougham, Official Receiver and Liquidator, has now issued his report to the creditors and shareholders. The statement of affairs shows unsecured debts, £3,896 12s. 1d.; loans on debenture bonds, £4,948 5s. 7d.; and preferential claims, £151 19s. 11d., a total indebtedness of £8,996 17s. 7d. The assets are returned at £10,402 5s. 5d., and consist of stock-in-trade, £50; machinery, fixtures, and fittings, £200; patents, £10,000; and good book debts, £152 5s. 5d.

The account with the contributories discloses a deficiency of £105,780 12s. 1d. Mr. Broughton reports that the company, which was promoted by the Founders' Syndicate, Ltd., was incorporated on April 10th, 1899, with a nominal capital of £150,000 divided into 150,000 shares of £1 each, 60,000 of the shares being 6 per cent. cumulative preference and the balance (90,000) ordinary shares. The company was formed for the purpose of acquiring the British patent rights in the Nodon-Bretonneau process of seasoning and preserving timber by electrical agency, and to commercially introduce the process into the United Kingdom. The qualification of the directors was the holding of 500 shares of the company, and their remuneration was fixed by the articles of association at £200 per annum, with an additional £100 a year to the chairman. They were, further, entitled to one-tenth of the surplus profits available for distribution in each year after 6 per cent. had been paid on the preference and ordinary shares. No fees had, however, been paid to them. Under the purchase agreement, which was made between the Founders' Syndicate, Ltd., who were the vendors, and the company, the purchase price was fixed by the promoters and vendors at £100,000, and was satisfied as to £11,307 in cash and £88,693 in fully paid ordinary shares. The preliminary expenses were paid by the Founders' Syndicate, Ltd., with the exception of the stamp duty on the purchase agreement. The syndicate acquired the English rights from a French company for £6,500 in cash and £43,500 in shares. It therefore made a nominal profit of £4,807 in cash and £45,193 in shares on the sale to this company. A prospectus was issued, and as a result some 28,000 shares were subscribed for. Upwards of 9,000 of these shares have been forfeited for non-payment of calls. The working capital at the disposal of the company on its commencing business was about £3,500 after payment of the part-purchase price. The company acquired a lease of land at Charlton and erected buildings thereon costing between £5,000 and £6,000. A jetty adjoining the works was also erected costing £700. To provide working capital for current expenses, cash advances were made from time to time by the directors and their friends, which, at the date of the winding-up order, amounted to about £4,948, and in respect of which debentures were issued charging all the assets of the company. No receiver had been appointed, the debenture-holders being treated as secured creditors in the liquidation. The directors also endeavoured to re-issue the cancelled shares, but without success. Very little trading, however, was done, and a large amount of the company's capital was spent in experimental work. The failure of the company is attributed by the directors to the want of working capital. The unsecured creditors (£3,896) are principally ordinary trade creditors and creditors for cash advances. The patents of the company are valued by the directors at £10,000, but it is extremely doubtful whether this amount will be realised. The books of the company have in recent years been most imperfectly kept, and it is impossible to ascertain the result of the company's trading.

Robertson Electric Lamps Fire Brigade.—At the Crystal Palace on Saturday last the competition for the championship of the private fire brigades of the United Kingdom was held. Brigades from Manchester, Leicester, and other parts of the kingdom took part. The teams consisted of five men from each brigade, who had to don hats, coats, and belts, and then run out five 50-ft. lengths of hose coiled up, turn on the water, and strike two targets which were placed about 200 ft. away. The Robertson Electric Lamps Brigade tied for first place, doing the drill in 70⅘ sec., whilst other teams ranged from 76 up to 98 sec. In all 18 brigades took part in the competition, so that the Robertson Brigade may congratulate themselves on the smartness of their performance.

Smoke Nuisance.—The Scarborough Electric Supply Co., York Place, was summoned the other day for smoke nuisance. The magistrates said that they were satisfied the company had done everything reasonable to alleviate the nuisance, and therefore the case would be dismissed.

Book Notices.—*Hawke's Maximum Telegraphic Cyphers.* Framed specially to conform to the regulations of the Telegraphic Conference (London), 1903, providing 640,000,000,000 pronounceable code words. Price £1 10s. Mr. W. H. Hawke, the compiler, who is also author of the Premier Code and supplements, &c., will, he states, save the users of his system 50 per cent., and also "the real position is that firms *not* availing themselves of the system are paying *fully double the cable rates of those who do.*"

As, according to our opinion, the value to the public of a code system generally hinges upon the financial benefit to be derived therefrom, we deal with this aspect of the question only. As far as errors are concerned, the public find that cable and telegraph companies generally quickly obtain corrections for them. We have reviewed in our columns from time to time systems invented by various gentlemen, some of whom have claimed a saving of 75 per cent. on the cost of telegraphing. But we feel that, since the sending of 10-letter pronounceable groups has been authorised, systems claiming a large saving of cost must be counterbalanced, and it is for the public to decide which system they will prefer and will adopt.

Regarding the question of telegraphic codes in general, it may be accepted that, as far as the Official Vocabulary was concerned, the supporting Governments were defeated by the commercial communities, who did not approve of the words it contained. It seems curious that so much work and time should have been expended on the compilation of a Vocabulary to remedy an acknowledged evil, eventually to cast it aside as useless and make no attempt to perfect it, but to accentuate the evil by falling back upon a code system composed of 10-letter pronounceable words, according to the usage of any of the languages to which code words have hitherto been limited, viz., English, French, German, Dutch, Italian, Spanish Portuguese, and Latin. Under these conditions, it is, we think, impossible to define "pronounceable." We cannot picture an English counter clerk arguing with a sender if "schubschen" or "Klatschchen" are pronounceable in German or not, and we venture to suggest it will require a tongue from each of the above eight countries to roll off with anything like telegraphic expedition many of the words presented. It is, of course, possible in time to knead a telegraph operator into dough of any consistency, but we think very little discrimination will be shown, and everything accepted in sheer desperation.

If, therefore, an impossible system has been accepted, and the Government Vocabulary killed, an attempt to regulate it as far as possible might be worth while. We have in our columns repeatedly voiced the advantages of a system similar to that devised by Mr. James Nicolson, a telegraph superintendent and expert of many years' standing, knowing all the intricacies of working, and aware of the pitfalls and snares always coming to the hard-pressed operator.

The delegate of the Argentine Republic, at the last Telegraph Conference, suggested the adoption of the "Nicolson" system, and we believe it is very favourably looked upon by most, if not all, cable companies (portions having been adopted by several of the most important for administrative purposes), only there is a lack of co-operation, and apparently a "tired-out" feeling among them, which makes them look upon a vocabulary or system of coding as a *bête noir*.

Mr. Nicolson claims the following advantages for his system:—(1) The selected telegraph signals represent invariably two alternating series of "odd" and "even" numbers of electrical impulses; (2) The selected vowels and consonants are arranged invariably in alternate order, therefore any other orthography will not correspond to the system; (3) The words are restricted to even numbers of letters, viz., 8, 10, so that a letter cannot be dropped or added; (4) Only 58 per cent. of the letters of the alphabet are selected, hence the discarded letters cannot be substituted without creating an apparent irregularity; (5) Words beginning with a consonant are inverted, so that their reciprocals beginning with a vowel, act as a key in case of an improbable error; (6) The words differ from each other by two letters; and (7) Each consonant being accompanied by a vowel renders the words pronounceable.

"Electricity in the Service of Man." New Edition. By R. Mullineux Walmsley, D.Sc. London: Cassell & Co., 10s. 6d. net.

"The Engineering Press Monthly Index Review." London: Technical Press Association. 1s.

"Electrical Engineering for Students." By S. R. Bottone. London: Guilbert Pitman. 2s. net.

"Laboratory Handbook of Electro-Technology." By W. Brown and R. G. Allen. Dublin: Sealy, Bryers & Walker. 5s. net.

"Machine Drawing for Students Preparing for the Science Examinations in Technical Institutes and Evening Schools." By A. P. Hill. Westminster: P. E. King & Son. 2s. 6d. net.

"Central Electrical Stations: Their Design, Organisation, and Management." By C. H. Wordingham, A.K.C. Second edition. London: Chas. Griffin & Co.

"Elementary Manual on Applied Mechanics." By Prof. Andrew Jamieson. Sixth edition. London: Chas. Griffin & Co.

"Report of the Board of Education for the Year 1903-4." London: Eyre & Spottiswoode. 5½d.

LIGHTING AND POWER NOTES.

Bristol.—There was no opposition at the L.G.B. inquiry held on 16th inst. into the application to borrow £126,500 for electric lighting purposes.

Caversham. — The Lighting Committee has recommended the T.C. to apply for a prov. order for supplying electrical energy within the district. The Reading Electrical Supply Co. has informed the Council that in the event of the latter obtaining an order, the company would be prepared to treat for a bulk supply.

Claremont (W.A.).—A case regarding the lighting supply of this town recently came before the Acting Chief Justice of W. Australia. The Municipal Council brought an action against Messrs. Splatt, Wall & Co., in which it sought to restrain the defendants from carrying their electric wires over the roads of the municipality. Wires were carried across two streets for the purpose of lighting premises by electricity. Evidence proved that the soil of one of the roads was vested in the municipality, but not so the other; no evidence could be found that the street was proclaimed by the Crown as such, it originally being set apart as a road by a private owner of the original estate. Stay of proceedings was granted, his Honour remarking that the matter being of considerable importance, it would be of interest if carried to the Court of Appeal.—*Australian Mining Standard.*

Dulverton.—Referring to our note in last week's issue, we are asked to state that the whole of the work in connection with the Dulverton Electric Light Co.'s installation was carried out by Messrs. Edwards & Armstrong, of Cardiff and Bristol.

Germany.—The municipal authority of Schweinfurt has decided to erect an electricity generating station in the town. The water-power of the River Main is to be utilised, and the plant to be put down includes a 400-H.P. turbine and dynamo.

Govan.—The T.C. has resolved to apply to the Secretary of Scotland for permission to borrow £47,000 for electrical purposes, thus increasing the Council's borrowing power under that head to £127,000. The sum already expended for E.L. purposes amounts to £71,247.

Holyhead.—The inauguration of the U.D.C. electric lighting and destructor works took place on the 16th inst. Lord Stanley of Alderley performed the ceremony of switching on the light. The scheme has involved an expenditure of £16,000, and includes a two-cell Meldrum refuse destructor constructed on the regenerative system with continuous furnace chamber, and a complete plant and mains for generating and distributing energy on the three-wire system. The Council acquired a steam mill for the works, situate in the King's Road, and the building has proved to be eminently suited for its present purpose, with ample room for extensions. The street lighting includes 10 arc lamps with about 240 glow lamps on standards. The present contracts provide for 100 consumers, 60 being already connected. Mr. Price F. White, of Bangor, is the consulting engineer for the scheme, and Mr. Philip Williams acted as clerk of works and resident engineer. The contract for the plant, mains, street lighting, &c., was entrusted to the National Electric Construction Co., Ltd., of 34, Victoria Street, S.W. Messrs. Meldrum Bros., of Timperley, supplied the destructor plant and Babcock boilers, and the Alphons Custodis Chimney Construction Co., Ltd., erected the shaft.

India (Madras).—Two applications for licences under the Electricity Act, of 1903, for supplying electricity within the city were submitted practically simultaneously. The first was by Messrs. Orr & David, a firm of local solicitors, on behalf of Messrs. Crompton & Co., of Chelmsford, for a low tension supply scheme. The most important feature in the application is the inclusion within the proposed supply area, of the area vested in the Harbour Trustees, which, of course, permits of the supply of power for the working of cranes, &c. The maximum charge suggested in the application for the licence is 12 annas per unit for power purposes. The other application, that of Messrs. Burn & Co., of Calcutta, also seeks to include the Harbour Trustees area. As regards the maximum prices to be charged, where the licensees charge any consumer by the actual quantity of energy supplied to him, they ask to be allowed to charge 8 annas for each unit used for lighting purposes only, provided that if in any month the value of the supply to the consumer at the rates actually charged does not amount to the equivalent of 1 anna per lamp installed (irrespective of C.P.), the licensees may charge a sum not exceeding that amount. For energy used for power purposes the maximum charge is to be 4 annas per unit, and for public street lighting 2½ annas per unit, the maximum payment per annum for such lighting to be 10,000 rupees. The licensees also undertake to erect and equip two refuse destructors combined with two electricity stations or one large electric station, for supplying all the light and power required. The Municipality on its part is to deliver a certain fixed quantity of refuse, and to pay the actual cost of burning the same at the rate of 2½ annas per 40 cb. ft. The licensees, at their discretion, are to have the right of remodelling the old lamp-posts, to make them suitable for lighting by electricity, or of providing new posts, the cost to be borne by the Municipality, and also seek to have the right of supplying electricity in bulk to the Municipality for sewage pumping. The Indian Electricity Act, of 1903, on its enactment, was heralded in some circles as the precursor of an era of electrical activity in the larger cities, and for a city which was the first in British India to possess electric tramways, Madras has been astonishingly behindhand in securing a supply of electricity for lighting purposes. Perhaps the early experience of an unsuitable conduit system which gave way to the trolley system of electric traction may have had something to do with it.

Darjeeling.—From a Calcutta source we learn that the Darjeeling Municipality has been granted powers under the Indian Electricity Act, of 1903, to supply electricity within parts of the town and neighbourhood.

Italy.—The municipal authority has decided to put down a plant to light Cosenza by electricity.

Jedburgh and Melrose.—The Electric Supply Corporation recently appealed against the valuation put on its generating stations in these towns; the Jedburgh valuation was reduced from £240 to £180, and that of Melrose to a similar extent.

King's Lynn.—The L.G.B. has sanctioned a loan of £2,756 to the T.C. for electrical purposes, the sum being £78 less than that applied for.

London.—Hammersmith.—The L.G.B. has sanctioned, in order to avoid a disallowance, payments amounting to £309, made in connection with the purchase of electric motors for letting on hire or on hire-purchase. The Lighting Committee has decided to lay down a special main at a cost of £1,898, to give a supply to Olympia. The Society of Motor Manufacturers and Traders are to hold the first of a series of exhibitions there in February, and have agreed to take energy at 4d. per unit, with a minimum payment of £500 for the first exhibition. The Society has further undertaken to continue as consumers during the three succeeding exhibitions.

Marylebone.—The B.C. has given notice that it intends to apply to the L.C.C. for approval to an alteration of the pressure of supply. At the present time energy is supplied to consumers at from 50 to 200 volts on the alternating and continuous current systems. The B.C. desires to alter this into a continuous supply at 240 volts.

Fulham.—The district auditor, in his annual report of the accounts of the B.C., takes exception to the electricity and dust destructor undertakings being treated as a single enterprise in regard to profit and loss. The cost of the destructor, he rules, should be charged directly upon the general rate fund, and the value of the heat supplied by it must be refunded out of the electricity revenue. Further, he states: "The cost of providing and maintaining the electric lamps and pillars for public lighting is also treated in the accounts as a charge upon the electricity revenue, and presumably taken into account in arriving at the annual charge upon the general fund for the lighting of each lamp. In this case also there does not appear to be authority in law for the charge upon the electricity revenue. The cost of providing the lamps should, in my opinion, be transferred to the general fund, and the charge for the supply of energy be based upon this fact."

Stoke Newington.—The local Ratepayers' Association has sent in a protest against further increasing the ratepayers' burden by the adoption of a scheme for electric light. The consideration of the Electric Lighting Committee's report submitting an agreement with the North Metropolitan Electric Power Supply Co. has been again adjourned.

Shoreditch.—A further extension of mains has been sanctioned by the B.C. at a cost of £640.

Londonderry.—The plant installed at the works inaugurated on 8th inst. to supply energy for private lighting purposes comprises three Lancashire boilers, each 7 ft. 6 in. × 26 ft., with a working pressure of 125 lbs. per sq. in., which were supplied by Messrs. Victor Coates & Co., Ltd.; Weir feed pumps of a capacity of 2,500 gal. per hour; Pulsometer Co.'s centrifugal pumps, two in number, 4-in. and 5-in. bore, direct coupled to Brush motors, provided with "no load" and "overload" automatic releases. Three Körting condensers of the ejector type have been installed, one for each of the 250-kw. sets, and one for either of the 100-kw. sets. The tanks have a capacity of 9,000 gal. The contract for the generating plant was given to the British Thomson-Houston Co., of Rugby, who sublet the contract for engines to Messrs. W. H. Allen, Son & Co., of Bedford. There are four direct coupled generating sets, two of 250 kw., to give 500 amperes at 500 volts, and running at 375 r.p.m., and two smaller sets of 100 kw., running at 450 r.p.m. All are six-pole machines, the two larger being shunt wound, and the two smaller, compound wound, this being so with a view to supplying at a future date, energy for tramway purposes. At present they will run as shunt machines. The balancer-booster set was also supplied by the British Thomson-Houston Co. The storage battery was supplied by the Electrical Power Storage Co., and consists of 268 cells, with a capacity of 50 amperes for 10 hours or a maximum discharge of 200 amperes. The switchboard contains 13 panels—four generator, two battery, one balancer, and six feeder panels. Plug bars are provided on all of these, enabling machine or feeder to be connected to either one of two sets of bus-bars. The contractors for this work were Messrs. Cox-Walkers, of Darlington. The distributing and feeder cables were supplied by the Western Electric Co., of North Woolwich, the feeders being triple-concentric, paper-insulated, jute-served, and lead-covered, drawn into conduits. Three-core pilot cables are also drawn into the conduits. The distribution cables are three-core, lead-covered, laid solid in earthenware troughs with bitumen. There are six feeders, of a total length of 4 miles, and the length of the distributors amounts to about 8 miles. The prov. order authorising the Corporation to supply electricity for public and private lighting was obtained in 1891. In 1894 the public lighting was commenced, and in April, 1901, the Corporation resolved to carry out the above scheme for private lighting. The specifications and plans for these new works were prepared jointly by Messrs. Preece & Cardew, of Westminster, and Mr. R. V. Macrory, the city electrical engineer.

Melbourne.—A curious sequence of events is reported from Melbourne, where a short circuit recently occurred in a street box, resulting in an explosion and the blowing off of the cover. The flames were quickly overcome, and normal conditions restored by the electrical staff. Incidentally, however, the telephonic alarms to the fire brigade headquarters were affected, and it is recorded that six fire equipments were dispatched in as many directions to cope with the supposed outbreaks; not only this, but half the shutters fell at the Central Telephone Exchange, and at a certain police station an officer was astonished to see the whole of the 50 indicators on the station telephone board, fall at the same time.

New Zealand.—The second reading of the Bill promoted by the Waipori Falls Electrical Power Co. has been agreed to in the House of Representatives. All the local bodies except the Dunedin City Council are favourable to having the power brought within their districts.—*Australian Mining Standard.*

Portmadoc.—A discussion ensued at a recent U.D.C. meeting as to the desirability of improving the gas works at a cost of £8,000, pending definite knowledge on the question of the E.L. facilities likely to be afforded under the Snowdon electric scheme. The Council resolved to support the latter scheme.

Ravensthorpe.—The U.D.C. has engaged Mr. Mountain to carry out the E.L. installation for the town.

Rhyl.—The U.D.C. has received from the L.G.B. sanction to raise a loan of £2,610 for E.L. purposes.

Saltney.—The Flintshire C.C. has decided not to object to the use of overhead wires for E.L. at Saltney, but at the same time the use of underground wires is recommended as being less dangerous to the public. Prohibition was not imposed, because it would hamper the attempt to obtain the E.L. for the parish.

Rathmines.—The following statement shows the results of the working of the U.D.C. electricity undertaking for the year ended March last, in comparison with that of the preceding year:—

	1904.	1903.
Revenue, private lighting	£4,197	£3,255
" public lighting	3,053	2,841
" meter rents and sundries	218	230
Total	£7,467	£6,326
Total working costs, including public lighting ..	£3,998	£3,712
Interest	£2,513	£2,410
Sinking fund	£1,768	£1,768
Deficiency on year's working	£812	£1,564
Total works costs per unit	1·874d.	1·822d.
Inclusive average price obtained per unit ..	3·501d.	3·591d.
Total number of units sold	511,761	422,769
Maximum load recorded	299 KW.	256 KW.
Total capital expended	£84,893	£74,261

Saffron Walden.—The L.G.B. held an inquiry recently into the application of the T.C. for sanction to borrow £9,950 for E.L. purposes. The town clerk explained that the contractors, Messrs. Foote & Milne, would take the responsibility, and carry on the works for fourteen years, when they would be transferred to the Corporation free of all charges. It is proposed to use the waterworks premises for the installation. There was some opposition.

Skipton.—The U.D.C. has decided to abandon its E.L. prov. order, and has received sanction from the B. of T. to the revocation.

Sunderland.—The Electricity and Lighting Committee recently submitted its estimated expenditure for the ensuing half year, which is as follows:—Total expenditure, £13,371; total revenue, £27,695; and a gross profit of £14,324.

In order to meet the demand for energy for motive power purposes, the T.C. has resolved to extend the plant at the Hylton Road supply station, at a cost of £3,000.

Whitby.—There was no opposition at the L.G.B. inquiry into the Council's application for a loan of £3,100 for electric lighting purposes.

TRAMWAY AND RAILWAY NOTES.

Adelaide.—On August 16th the Premier of the State of South Australia (Mr. J. G. Jenkins) obtained leave to introduce a Bill to authorise the Government to purchase certain of the tramways of Adelaide, and to convert the same for electric traction. In reply to a question, he stated that it was the intention of the Government to obtain the advice of an expert in the matter of electrification before deciding upon the acceptance of any tenders. This signifies that in spite of the reconstruction of the Cabinet, there is to be no change in the general tramway policy of the Ministry; though seeing that the Labour party are now entirely upon the opposition side of the House, and no longer hold the balance of power, there is more probability of a full consideration being given to any offer for a lease of the lines.

Belfast.—At last week's meeting of the Tramways Committee, Messrs. Henry A. Cutler (city surveyor), V. A. H. M'Cowen (electrical engineer), and Andrew Nance (manager of the tramways), presented a joint report, stating that they were preparing a specification, in which Mr. Cutler was paying special attention to the permanent way, Mr. Nance to the cars and depôts, and M'Cowen to the generating station and the overhead works. The reconstruction of car-sheds was to be deferred for the present, and the officials asked that the Committee should decide as to whether all the existing lines should be reconstructed as double lines; that the five following authorised extensions be agreed to:—Greencastle, Duncairn Gardens, Shankill Road, Newtownards Road, and Cliftonville Road that rosettes should not be attached to buildings, but side poles generally adopted, with centre poles in the principal thoroughfares and that interlaced lines be used in Great Edward St., this being a narrow thoroughfare. They were also of opinion that the traffic should be stopped road by road as the works proceeded, and that they should be empowered on completion of the specification to take the necessary steps by advertisement to obtain tenders to have the work done by contract. The joint specification was generally adopted, but the Mill Street and Castle Street extension was decided on; in addition, the present Falls Road route *vid* College Square is to be abandoned. In the construction of the permanent way each contractor tendering will be required as a condition of his contract to carry out the general work by giving a preference to local labour. The question of a consulting expert was considered, but it was not deemed necessary to appoint one. The electrical engineer was instructed to report to the Committee if any special points were likely to call for expert advice.

Cambridge.—The T.C. has resolved to support the Bill being promoted by the local electric tramways syndicate, to conditionally waive the right to acquire the present tramways in 1907 until 1947, and that in return for these concessions the Council shall have the right to purchase the undertaking in the following years:—In 1914 as a going concern provided the sum to be paid shall not be less than the amount the company has *bonâ fide* expended; in 1925 as a going concern without any proviso; and in 1947 and after that after 5 per cent. has been paid to the shareholders, one-third of the net profits shall be paid to the Corporation.

Cawnpore.—The Calcutta *Englishman* says that an order has been published in the *United Province Gazette*, authorised Messrs. Begg Sutherland & Co., of Cawnpore, to construct an electric tramway from the East Indian Railway Station to the Grand Trunk Road at its junction with Harrisganj. The line is to be commenced on or before November 30th, this year, and completed and opened for traffic within two years from date of commencement. The system adopted is the overhead trolley.

Handsworth.—No settlement has been arrived at yet between the U.D.C. and Staffordshire Tramways Co.

International Tramway Conference.—The annual conference of the International Tramway and Light Railway Association was held in Vienna in the second week of September, under the presidency of M. Janssen, of Brussels. Dr. Ritter von Wittek, Austrian Railway Minister, welcomed the members and representatives of other Governments.

M. Petit, of Brussels, presented a paper on protective devices against the falling upon the trolley wires of electric tramways of conductors carrying weak currents, and giving the results of a circular inquiry undertaken by the Association in regard to the subject. The author arrived at the conclusion that a complete guarantee of safety was not afforded by any of the existing methods. In his opinion, if it were not possible to entirely obviate crossings by the laying underground of conductors conveying weak currents, a reduction in the number of crossings should be effected by the combination of these conductors in bunches or bundles. It was just for the owners of heavy and light current conductors to take the necessary precautionary measures, and jointly bear the expenses instead of the latter being exclusively imposed upon the tramway companies.

Herr Vellguth, general secretary of the Association of German Tramways and Light Railway Administrations, submitted a paper dealing with the control of transfer tickets in tramway working. As a result of observations, he stated it was impossible to propose a solution which could be of general application. It could only be said that the effect of an alteration in the tariff, or the control, could only be predicted on rare occasions, and that even insignificant changes might have totally unexpected results. It was, therefore, the author concluded, only desirable to proceed with alterations when necessitated by extraordinary circumstances.

M. Pavie, of the French General Tramway Co., of Paris, brought forward the question of the advantages and disadvantages of trailer cars on city tramways. After discussion, it was decided to agree with the author in his advocacy of the abolition of the regulations which prohibit certain companies from employing more than one trailer, with the exception of special cases, as for instances where heavy down gradients exist.

Herr Klitzing, of the Magdeburg tramways, followed with a report on economy in the consumption of current in tramway working. He showed that by means of mechanical control of the drivers, and the granting of bonuses for economical operation, it was possible to effect a saving in the amount of current used for traction purposes. It was decided to defer the consideration of the report until the next general meeting.

Herr Pforr, of the Berlin Allgemeine Co., then raised the question as to the most suitable form of current—three-phase or single-phase alternating or direct current—for electrically operated light or local railways. The author came to the conclusion that it was essential to obtain further experience before arriving at a decision, and the meeting resolved that a further report should be prepared for submission to the next conference. A translation of Herr Pforr's paper was printed in our issue of 2nd inst.

Among other papers presented to the meeting may be mentioned those which discussed the questions of appropriations for the renewal fund of electric tramways, automobiles on light and local railways, measures for the prevention of disturbing influences being produced in measuring instruments in electrical and physical institutions, systems of braking, and the control of electrical installations, and the maintenance of tramway trolley conductors.

Liverpool.—A special meeting of the City Council has been called for October 20th, to consider proposals for the extension of existing tramways in the city, and the construction of "light railways within and without the city." Resolutions for the carrying out of certain works will be submitted, and should the necessary two-thirds majority of the Council approve of proceeding with the works, application for powers to construct will be made. With regard to the light railways, one proposal will be for the construction of a single line between Wavertree and Garston, to the east and south of Liverpool, of a length of four miles 1,400 yds. Also, to construct a line on the south-east of the city, measuring 880 yds. of double track and 1 mile 1,340 yds. of single track. Another connecting length on the south-east of the city is proposed, and also the construction of a single line 4 miles 1,460 yds. long to connect a northern point, Breeze Hill, with Knotty Ash on the east. A considerable part of the routes indicated lies outside of the city boundaries.

London.—A motor-car was smashed between two electric tramcars coming from opposite directions on the L.U.T. Co.'s system at Shepherd's Bush, on the 16th inst.

Manchester. — The experiments of the Corporation tramways department with covered cars have proved so satisfactory that it has been decided to largely increase the number in use, especially during the winter months.

(*Continued on page* 504.)

THE THREE-PHASE 40,000-VOLT POWER TRANSMISSION FROM GROMO TO NEMBRO (LOMBARDIA).

The Serio, a swift flowing mountain stream taking its origin in the Alps north of the industrial town of Bergamo, in Lombardia, and flowing through the picturesque Seriana Valley, was found to be capable of developing 4,000 H.P.; 2,000 at Gromo, and another 2,000 at a point higher up the stream. At present the river has only been utilised at Gromo.

The problem which had to be solved by the engineers was as follows:—"2,000 H.P. available at Gromo must be converted into electrical energy and transmitted by means of one or two three-phase overhead lines to Nembro, a small town some 35 kilometres distant, where the spinning mills of Messrs. Crespi and Co. have to be driven. At first one line only shall be erected, although the possibility exists that a second one will be laid for carrying the energy to a greater distance. Provision must therefore be made for ultimately fixing this second line on the same poles as are used for the first. Assuming that all the available energy will be utilised, the loss in the line must be a minimum, although it is equally essential that the prime cost of the installation be kept low. As regards the plant itself, the whole must be carried out in a clear and simple manner, so as not to complicate manipulation or endanger the safe working of the system."

These were the conditions which had to be fulfilled. The carrying out of this scheme was entrusted to the able and experienced hands of Messrs. Brown, Boveri & Co., of Baden; how they acquitted themselves of their task, and the reasons which prompted them to adopt an extra high working pressure for a medium-sized power transmission for a comparatively small distance, remain to be explained.

The preliminary tender submitted to the client was worked out on the following basis:—"2,000 H.P. to be transmitted by three-phase currents at a pressure of 30,000 volts. The line to consist of three bare copper wires of 6·5 mm. diameter each, giving a drop of approximately 4 per cent."

The above data really represent the ideal conditions for this particular installation, and it would have been impossible to obtain as satisfactory results with a lower working pressure. As regards the additional 2,000 H.P., which would have been utilised at a future date, this would have been transmitted by a similar line on the same set of poles.

However, several difficulties cropped up which would have rendered the above scheme unpractical. The erection of a second line without interrupting the service of the first would, in this particular case, have presented great difficulties. Moreover, although at first glance one feels inclined to consider a double transmission line advisable so as to guard against breakdowns, this advantage does not exist in practice when the two lines are mounted on one and the same set of poles.

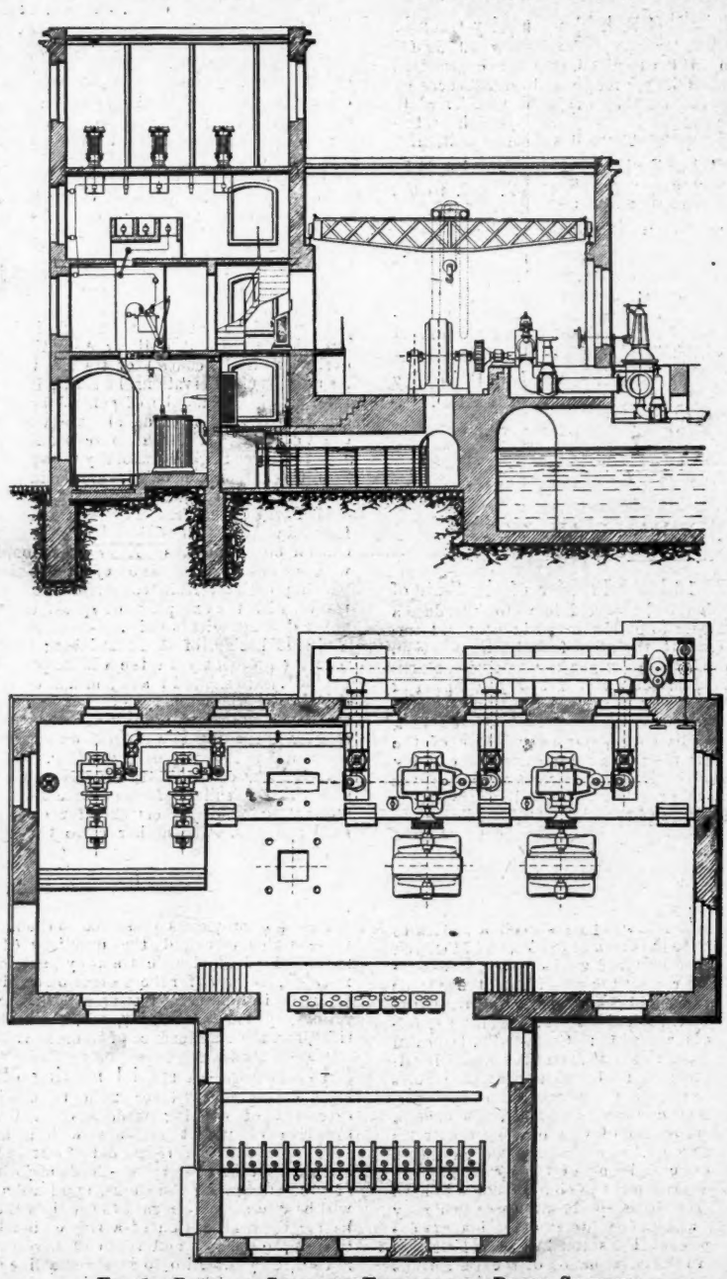


Fig. 1.—Plan and Sectional Elevation of Power Station.

As two sets of poles were excluded on account of the prohibitive monetary outlay which this course would have entailed, the only remaining solution was to design the line from the very commencement for a 4,000-H.P. transmission. In order to keep down the drop in the line to 4—5 per cent. with this increased output, either the sectional area of the copper conductors would have to be enlarged, or the line voltage raised. Both solutions result in an increase in the capital outlay. Augmenting the sectional area meant a proportionally high increase in the copper, and therefore the cost of the line, while the alternative necessitated more costly insulating material. The cost of the first plan, however, far outweighed that of the second, so that the latter course was favourably considered. Moreover, raising the line pressure to 40,000 volts had no serious drawbacks, as this latter pressure was quite as suitable and offered as much security for safe working as 30,000 volts, providing suitable apparatus was employed; so that, after having duly considered the pros and cons of each scheme, it was decided to abandon the original one and to adopt the second project—*i.e.*, to dimension the line from the very beginning to transmit 4,000 H.P. at a pressure of 40,000 volts.

The central station (figs. 1 and 2) has been built in the valley a few minutes' walk from the village, and at the foot of the mountain on whose face the top part of the penstock

has been laid. The lower portion of the pipe line, right up to the power house, was placed underground.

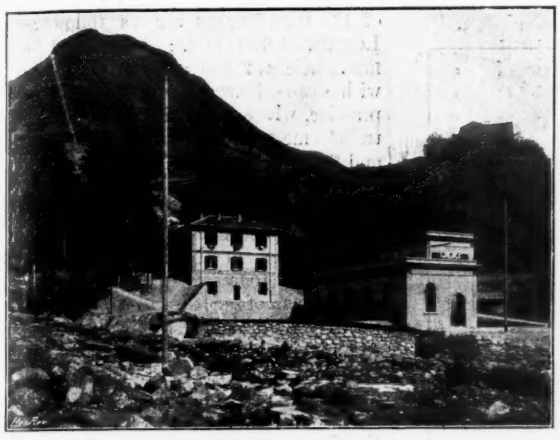


Fig. 2.—Gromo Power Station.

Fig. 1 shows a ground plan and a transverse sectional view of the power house. Three generators of 1,000 H.P. each, direct-coupled to Escher-Wyss turbines by means of Zodel couplings are placed in a row. Behind the generating sets two exciters, also direct driven by water wheels, and each having a capacity of 25 KW., have been put down. The third generating set has been provided as a reserve in case of a breakdown.

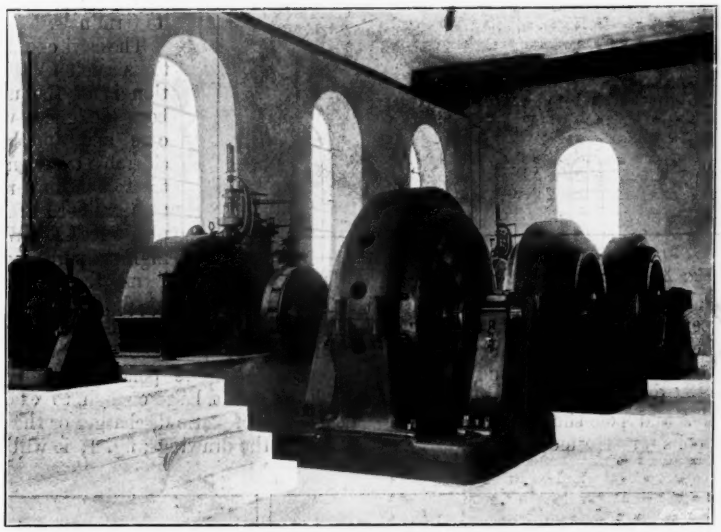


Fig 3.—Brown-Boveri Alternators, Driven by 1,000-H.P. Escher-Wyss Turbines.

The connections in the generating station have been arranged with a view to securing the maximum simplicity and economy, and differ markedly in many respects from those which have been generally adopted in this country and America. Each generator works directly on to the primary of an 850-K.V.A. stationary transformer, *i.e.*, without any instruments intervening. The total power leaves the secondary terminals at a pressure of 40,000 volts, and is then led to the high-pressure bus-bars, in order to allow of parallel running with the other units. The switches necessary for effecting paralleling are thus situated in the 40,000-volt transformer circuit.

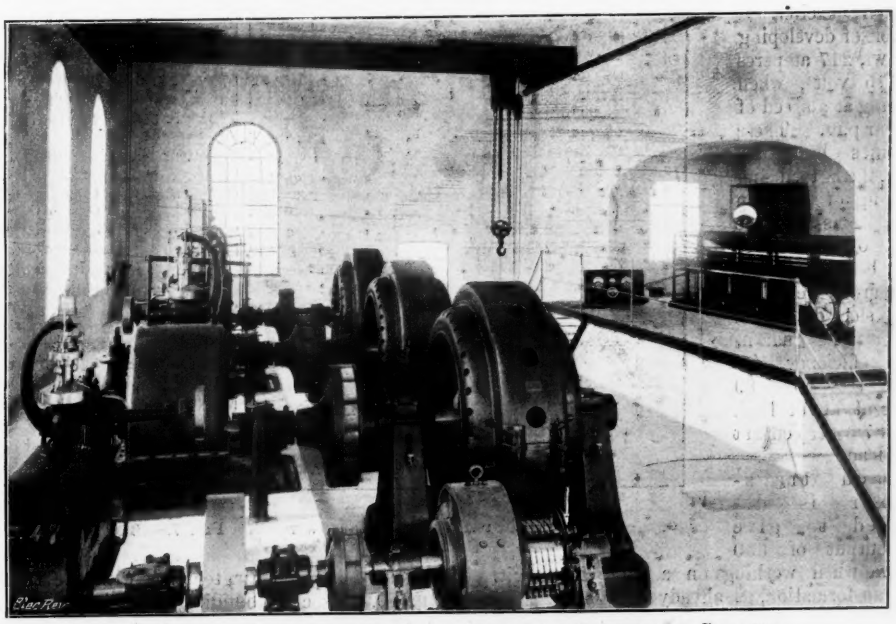


Fig. 4.—General View of Generating Plant and Switchboard Gallery.

The turbine, generator, and transformer, really form one unit. This method of grouping three units of a distinct order together, has lately been adopted in water-power plants (the same was done in the Como 20,000-volt installation) and marks an epoch in central station practice.

As our readers will remember, a similar arrangement was advocated by Messrs. C. H. Merz and W. Maclellan, in their paper on "Power Station Design," read before the Institution of Electrical Engineers in April last, and reprinted in the Electrical Review during May and June. The authors, in fact, adopted this principle in laying out the Carville Power Station of the Newcastle-on-Tyne Electric Supply Co., and carried it further, so as to definitely associate a group of boilers with the generating plant which they supplied with steam. It is almost needless to point out the gain in simplicity resulting from this arrangement, doing away with complicated cross-connections and alternative ways of coupling up the respective items of the plant; and simplicity is the key to reliability, the most desirable attribute of modern electricity supply undertakings.

By eliminating the bus-bars between generators and transformers, the number of controlling and measuring apparatus is practically halved. The current and pressure transformers for ammeters, voltmeters, and the overload relays of the automatic switches are energised from the low pressure—*i.e.*, 4,000-volt—side. Remembering that the ratio of transformation of the transformers is as 1 : 10, it follows that the ammeters and voltmeters indicate simultaneously the current, pressure, and phase difference of both the 4,000-volt and 40,000-volt circuits. Another great advantage is that the pressure transformers are considerably cheaper for the lower voltage.

The generators (figs. 1, 3, 4) are of the standard horizontal shaft type, with stationary star-connected armature and revolving field magnet. Each machine has a normal

continuous output of 1,000 H.P. on a power factor of 0·80, at a pressure of 4,000 volts. The machines are 12-pole, and run at a speed of 500 r.p.m., corresponding to a frequency of 50 cycles per second. The guaranteed efficiency, including excitation losses, was 93 per cent. at full load, and 89·5 per cent. at half-load. The drop of voltage from no load to full load was found to be, on a power factor of unity, 7 per cent., and on a power factor of 0·80, 20 per cent.

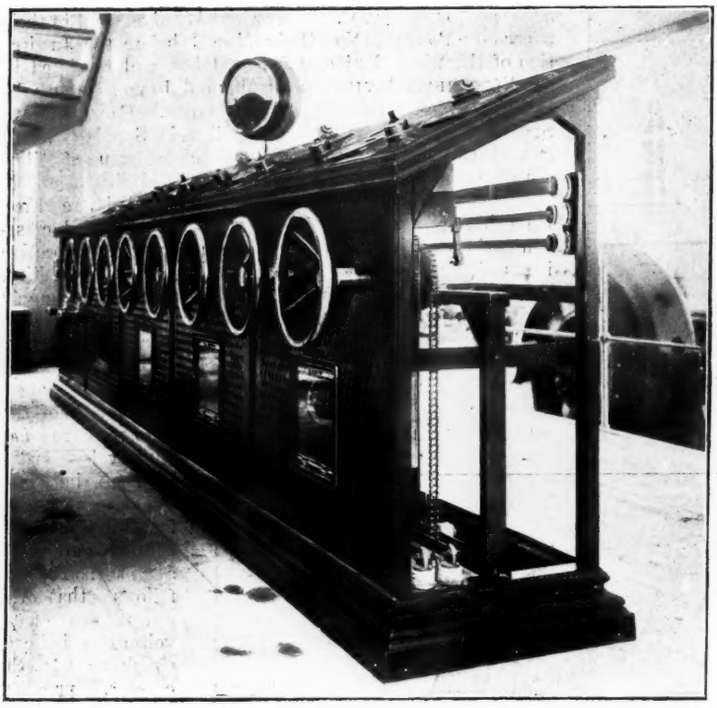


FIG. 5.—MAIN OPERATING BOARD.

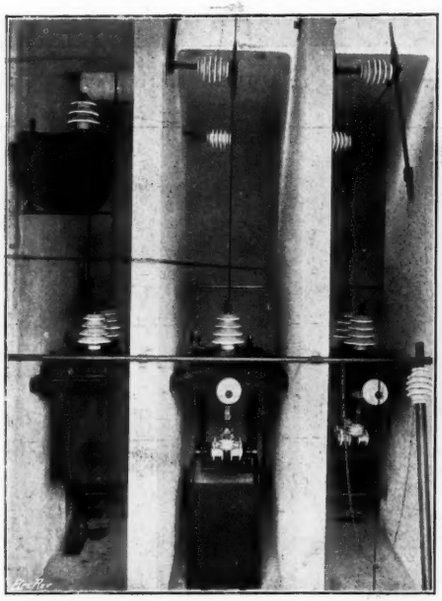
The magnet-wheel, poles, and pole-shoes form one steel casting. The armature coils are former wound. The weight of the complete machine amounts to 13 metric tons, being 13 kg. per brake horse-power.

Each exciter is capable of developing 25 KW., 217 amperes at 115 volts, when running at a speed of 800 r.p.m. These dynamos have six poles, the latter being built up of soft-iron laminations. The dynamo frame is of the best cast-steel. The armature is of the slotted drum type. The guaranteed efficiency for these sets was 89 per cent. at full load, and 87·5 per cent. at half load.

Each transformer is designed to give an output of 850 K.V.A. when working on a 50-cycle circuit. The ratio of transformation, as already mentioned, is 4,000 : 40,000. The efficiency obtained on a non-inductive load was 97·8 per cent., as against 97 per cent., the guaranteed figure; the inherent regulation, *i.e.*, the drop of voltage from no load to full load, on a non-inductive load was 0·76 per cent., and with power factor 0·7, it was 2·6 per cent. These apparatus withstood a flash test of 67,000 volts applied between primary and secondary windings. The overall dimensions of the transformers are as follows:—Length, 1,600 mm.; breadth, 1,360 mm.; height, 2,180 mm. In accordance with Messrs. Brown, Boveri & Co.'s usual practice, where water is plentiful, these transformers are of the oil-insulated and water-cooled type; the quantity of water required for cooling the apparatus averages 18 litres per minute. Each transformer consists of three vertical limbs placed in the same plane, and held firmly together at both extremities by means of soft-iron yokes. The primary and secondary windings are wound in the shape of concentric cylinders, and are separated from one another by means of a strong insulating partition. To remove as far as possible the danger of a breakdown, the high-pressure coil is wound in sections. Each sub-division has a potential difference of only 300 volts between its terminals.

The switchgear, which in installations such as the one under consideration is of the utmost importance, has been designed with exceedingly great care and forethought, and the considerable experience gained by the contractors in similar work has been brought to bear in order to render the plant a complete success. When dealing with extra high pressures, it is bad practice to try to cramp the apparatus together; it pays to dimension everything in a liberal manner. All insulation used in this installation was of the highest grade procurable, and the distances between conductors of opposite polarity, and between conductors and earth, were left large enough to exclude all danger of the occurrence of static discharges or the formation of arcs.

From the drawings, fig. 1, it will be noticed that all the switchgear, together with the transformers, is erected in a special building adjoining the engine room. The switch house consists of a basement and three storeys, each of the latter having a floor space of 10 × 7 m². The basement is again sub-divided into two compartments, the first one being



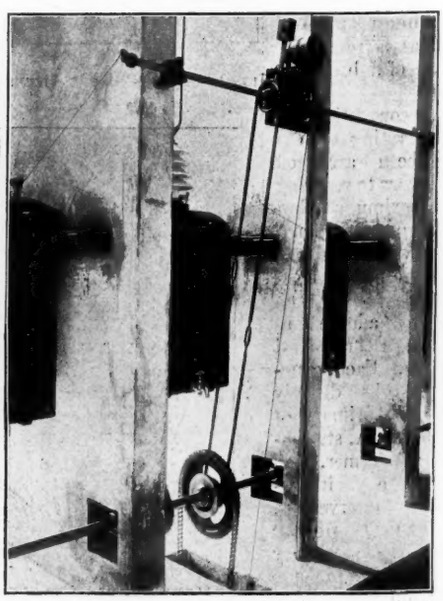


FIG. 6.—FRONT VIEW OF 40,000-VOLT OIL SWITCHES. FIG. 7.—BACK VIEW, SHOWING AUTOMATIC RELAY.

situated 1·2 metres below the engine room floor level, and containing the regulating resistances and framework for the 4,000-volt apparatus; the second compartment is situated 2·7 m. above the engine house floor, and holds the transformers. The leads from the engine room reach the first compartment through a wide trench provided under the engine room floor.

The first floor is also sub-divided into two rooms; one gives access to the engine room, forming a kind of gallery whence the whole of the installation can be surveyed. This compartment contains the main operating board with the switch handwheels and measuring instruments; in the second room the high-pressure automatic switches, together with the three current transformers for the outgoing feeder, are erected.

The 4,000-volt conductors, the exciting leads for the generators, and the exciter leads themselves are all placed in one common trench under the engine room floor, which leads into the basement. The second floor has been entirely taken up by the omnibus-bars, and the pressure transformers connected therewith.

The third floor has been reserved for the lightning arresters and the leading-out arrangements of the line.

Each generator has its own framework for carrying the following apparatus:—Three high-pressure single-pole removable tube type fuses with blow-out horn, one pressure transformer with fuses, and two current transformers.

The framework is a riveted structure made completely of iron, the lateral sides covered with embossed sheeting. At the front, removable shields have been provided in order to permit renewal of the fuses, or inspection of the same when necessary. The leads enter the transformer room through thick glass tubes cemented into the dividing wall.

In laying out the 40,000-volt apparatus, the extra high pressure bus-bars were taken as the starting point. In order to exclude all possibility of arcs being formed between bars of different polarities, each phase was enclosed in a separate cell made of incombustible material. The thickness of the walls of these cells is 120 mm. Great care was taken in obtaining a mechanically strong and at the same time electrically efficient insulator. The ordinary type on the market proved unsuitable, and a special type was therefore designed to meet the circumstances. This insulator consists of three parts, glazed separately but baked together. The main body of the insulator has four deep grooves. Each insulator has to withstand a test of 100,000 volts before being delivered.

Immediately below the extra high pressure bus-bars, on the first floor, the high pressure oil switches have been erected.

Fig. 8.—Nembro Sub-station and High Pressure Line.

To avoid the use of heavy apparatus, each phase has been equipped with a separate switch. The three elements are, however, operated simultaneously. (See figs. 6 and 7.) A similar structure was adopted for carrying the switches as for the bus-bars, and each switch is separated from its neighbour by a wall of 120 mm. thickness. The brackets and supports for the switches have been cemented into this wall. In this way each switch is placed in a fireproof cell of 600 mm. width. Through an aperture at the top, the connections pass from the switches to the bus-bars. Removable disconnectors have also been provided, which permit one to isolate any of the cells when the same have to be switched out of circuit to be cleaned or inspected. The disconnectors are composed of copper strips with stop split-pins (fig. 6.) These copper strips fit into two contacts mounted on porcelain insulators. They are handled by means of a wooden rod provided with an insulator at its extremity. To further safeguard the attendant, the bush by means of which the insulator is fastened on the stick is earthed through a little metal chain; this enables the attendant to operate the disconnectors, when the switches are open, without running any risk (fig. 6.) The switches embody all the main features of the standard Brown, Boveri oil switch, but as they are adapted for 40,000 volts they possess some interesting features.

The switch is operated from a distance by means of the hand wheel on the main board, and is actuated by a rotary motion. The latter is probably the most suitable mechanical movement for appliances of this kind, a great advantage being that one is not tied down to a particular spot for placing the switch, for, by means of a countershaft, the apparatus can be controlled at almost any distance.

Fig. 9.—Views of 40,000-volt Transmission Line.

The switches are of the multiple-break type. Both the moving and stationary contacts, as well as the mechanism, are immersed in an oil bath, so that nothing appears above the surface of the oil but insulating material and the earthed parts of the apparatus.

The oil reservoirs are quickly and easily lowered to give access to the contacts. All current-carrying parts have been solidly constructed, and are of ample cross-section. To avoid fusing of the main contacts, small auxiliary ones have been provided, which carry the current at the moment of breaking the circuit. These contacts are easily renewable. To make sure that the spark produced when breaking the circuit is quickly destroyed, the contacts have been formed in such a way that, at the moment of rupture, a volume of oil is forcibly thrown against them.

In order to weaken the destructive effect of the spark, the circuit is simultaneously broken in six places. By doing

this, a small travel for the moving contacts can be allowed. This travel, in the present case, amounts to 8 cm., thus giving an effective oil-break of 35 cm., after having subtracted the overlap of the contacts. This break ought certainly to be more than sufficient, even for a pressure of 40,000 volts. Moreover, the fact must not be overlooked, that, in three-phase working, two phases have to be considered as forming one circuit, thus giving 12 simultaneous interruptions per phase. Although, for the reasons mentioned, this switch was composed of three single-pole elements, the firm's usual practice is to combine them into one apparatus. The oil-baths are, however, kept separate, *i.e.*, one for each phase.

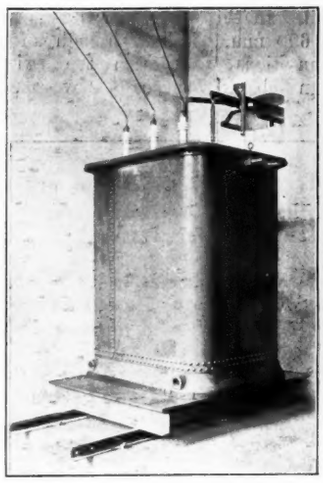


Fig. 10.—500-kw. Transformer.

Fig. 11.—Wurtz Lightning Arresters.

On turning the switch hand-wheel, the rotary movement is transmitted to the switch spindle, which, in its turn, actuates a crank. The latter moves the contacts and closes the circuit, and also puts under tension the springs fixed round the guides (see fig. 6).

If the switch is operated by hand, and by mistake the crank is turned past the dead point, the switch will, nevertheless, remain closed. When the switch is worked automatically, on the contrary, the crank never quite reaches the dead point, but is kept in position by means of a pawl and a cam-wheel. As soon as the pawl is lifted, the springs of the switch pull the contacts apart.

In the smaller type of switches, the catch is influenced directly by an electro-magnet. For larger types, as in this case, when three switches have to be released at the same time, a common release spindle is provided, and the break is effected by the falling of a weight. The position of the weight in its turn is controlled by an electro-magnet (see fig. 7). When the switch is closed the weight assumes its original position, and is ready for the next emergency. A driving shaft, common to the three switches, is supported in bearings fixed in the masonry walls, and operates the switch spindles through a chain drive. The switch hand-wheels on the main board impart motion to this shaft also through a chain drive.

As mentioned above, the energy which is stored up in the spring under tension separates the contacts. The driving gear, however, has to be turned to the "off" position by the switchboard attendant as soon as, and every time, a circuit has been closed. This is effected in the following manner; the chain wheel of the driving shaft is not keyed, but runs loose, on the latter. A pin projects from one side of this wheel, and travels in a semi-circular slot cut into the side of a little rope pulley keyed on to the driving spindle. When turning the chain-wheel clockwise, *i.e.*, when closing the switch, the projecting pin engages the little pulley, and the movement is transmitted to the driving spindle; on the other hand, when the chain-wheel revolves in the opposite direction, the stop turns idly round in the semi-circular slot

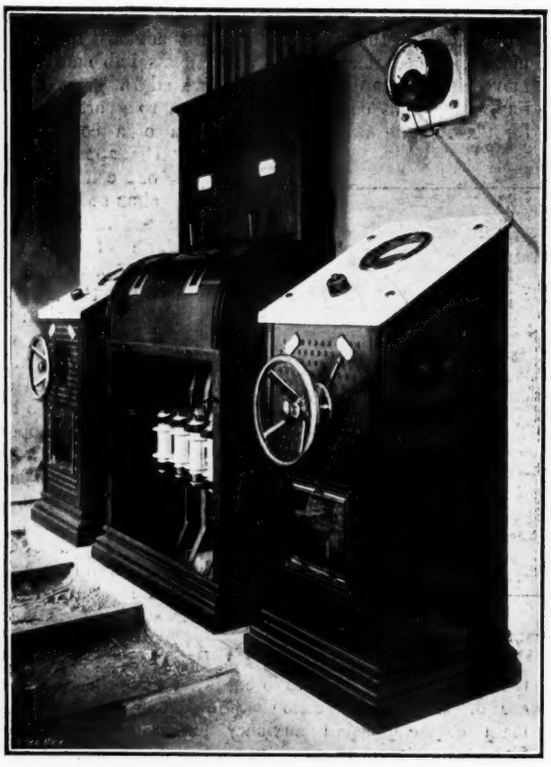


Fig. 12.—Switchgear in Sub-Station.

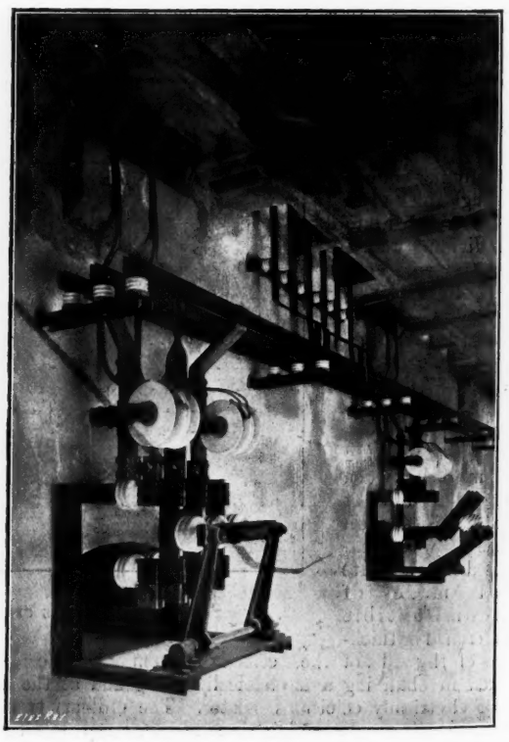


Fig. 13.—Low-Pressure Bus-Bars and Disconnecting Gear.

of the rope pulley. The rope pulley, of course, follows every movement of the driving spindle, and consequently of the switch spindle. By means of a catgut rope running over the pulley, and another pulley fixed on the spindle of the switch handwheel, a pointer is made to indicate the exact position of the contacts at any moment.

In order to refresh the memory of the attendant, an inscription "wheel to be turned back," appears as soon as the switch is closed. Should the operator in spite of this reminder still forget to return the hand-wheel to its off position, even then no harm will result, as it has been proved by tests that the springs of the switch are sufficiently strong to drag the whole driving gear back to its first position. Provision has also been made to open the switch by hand, should the relay fail to act. A knob passing through the centre of the switch hand-wheel, when pulled, lifts the pawl on the releasing shaft, and the switch opens in the usual way. Furthermore, by means of a push button, the solenoid circuit can be closed, and the switch opened. The overload relay, whose function it is to break the circuit through the action of the electro-magnet or solenoid, is designed on Ferraris' well-known principle. A light aluminium disk revolves between the poles of a single-phase electro-magnet, energised from the secondary terminals of a current transformer inserted in the main circuit. The torque produced by the eddy currents set up in the disk, which tends to make the disk revolve, is balanced by a small weight suspended from a silk thread. As soon as an overload comes on, the balance is disturbed, and the disk starts revolving, and winds up the thread on a little drum till the weight arriving at the end of its travel establishes contact between two springs, and thus closes the direct-current electro-magnet circuit. The length of the thread is, of course, calibrated for given overloads. The apparatus is therefore not only a maximum, but also an inverse time element relay—that is to say, the circuit will not be interrupted with a small overload, unless the latter lasts for a considerable period, while, in the event of large dangerous overloads arising, the breaking of the circuit will be effected very rapidly. This relay is usually single-pole, but two or three can be combined to form one apparatus.

The generator board (fig. 5) is built in the form of a desk, the top part inclining towards the operator. This inclining portion is made of cast-iron, and the measuring instruments are let in beneath its surface. The board is placed in the gallery giving access to the engine room, so that the attendant can survey the whole of the machinery, and at the same time have his hands close to the controlling apparatus. The operating board is only equipped with low pressure apparatus, and consists of three generator panels, one feeder panel, and one exciter panel. Each generator panel is equipped with the following apparatus:—Two hand-wheels, one serving for the high-pressure oil-switches, and the other for the pressure-regulating rheostat. The regulating hand-wheels of all three generators can be coupled together, so that the three units can be regulated together when running in parallel. Each panel has finally a two-pole overload relay. In the case of the feeder, this relay is of the three-pole type. The push button for the electric release of the high-pressure switches, as well as the phase lamps and tumbler switches for the same, is mounted on the desk. The exciter panel carries two hand-wheels for regulating the shunt of the dynamos, and two double levers for the two-pole switches. It may be of interest to British switchboard manufacturers to note that no marble or slate was used in the construction. The vertical sides of the boards are covered with ornamental embossed iron sheeting.

A bus-bar voltmeter is mounted on a bracket placed in a prominent position over the middle of the board.

The regulating rheostats, placed directly beneath the operating board, can be inspected without running any risk when the station is in full swing.

The third story has been reserved for the lightning arresters, each phase separated from the others by a partition. These arresters are of the well-known Würtz type, and are insulated from earth by several porcelain insulators.

On a level with the lightning arresters are the leading-out arrangements for the high-pressure line. Each line leaves the power house through one of the glass panes of the window. On both sides of this glass pane a stout glass tube projects, through which the conductor leaves the building. This tube is kept in place by two copper hoods soldered to the conductor. The tube is of such a length that the shortest path for leakage to a non-insulating body is 250 mm.

The total length of the overhead line (see figs. 8 and 9) is approximately 32 km.; it follows more or less the Serio River as it winds through the "Val Seriana" till Nembro is reached, where it drives the machinery of Messrs. Crespi and Co., of Milan, for treating cotton. The line has been calculated to transmit a total of 4,000 H.P., with a drop along the line not exceeding 5 per cent. The line consists of three highly conducting bare copper wires of 6·5 mm. diameter each, mounted on Delta insulators supplied by the well-known Hermsdorf earthenware factory.

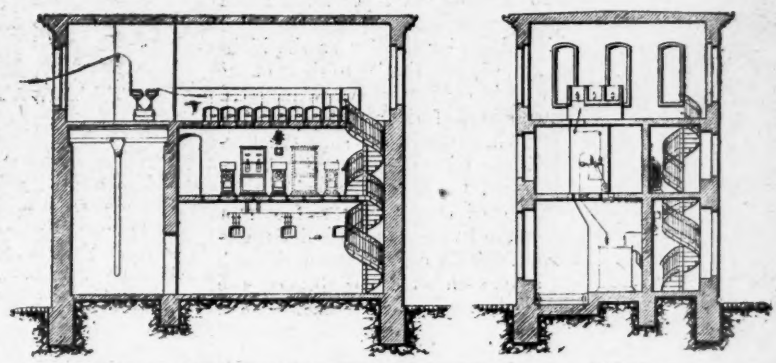


Fig. 14.—Sectional Elevations of the Sub-station at Nembro.

These insulators, which are protected by patent, are of a totally new design, specially got out for this installation. They embody all the advantages of the ordinary Delta-type insulator, but, in addition, have shown, by the following severe tests:—That the spark jumped across from top of insulator to iron support at a pressure of 89,000 volts when the humidity of the atmosphere amounted to 62 per cent.; that the spark jumped across from top of insulator to iron support at a pressure of 54,000 volts when the surrounding atmosphere was subjected to a heavy artificial rain covering the ground with 35 or 40 mm. of water in one minute; that the insulation resistance of each insulator amounted to several millions of megohms in a dry atmosphere, and to several thousands of megohms in an atmosphere saturated with moisture to the extent of 40 or 50 per cent. Each insulator finally had to pass a flash test of 80,000 volts without showing signs of breaking down.

The insulators are fixed on wooden poles and cross-arms. As a rule the lines are mounted on a single pole, in the form of a triangle with 850 mm. side. (See fig. 9.) The standard height of pole is 8 metres above the ground (9 m. at crossings). The lower insulators are placed at a height of 7·5 metres above the ground (8·5 m. at crossings). Where long spans and sharp bends occur, two poles have been erected and the insulators mounted on the cross beam at a distance of 1,000 mm. from centre to centre. The longest span is 120 m. (this considerably exceeds the limit allowed by the Board of Trade in England) and the sharpest angle 145°.

At San Carlo the line crosses an existing single-phase line of 2,000 volts, and at Albino a line and a canal. The average length of span from pole to pole is 40 m.

A telephone line connecting the power house with the sub-station is fixed on the same poles at a distance of 1·5 m. below the high pressure main line. This line consists of two silicium bronze wires of 3 mm. diameter each, mounted on ordinary insulators.

The transformer station is situated at Nembro, in close proximity to the factory. The line enters the building at a pressure of 38,000 volts, this being the voltage to which Gromo has to regulate the generating plant.

This station so far only contains two 500-K.V.A. transformers, of the same type and design as those at Gromo. Space has been reserved for a third.

These apparatus have been designed for a normal continuous output of 500 K.V.A. The ratio of transformation equals 38,000/500 volts. The efficiency obtained on non-inductive full load was 97·6 per cent., which compares favourably with 96·8 per cent., the guaranteed figure. The inherent regulation on non-inductive full-load was 0·8 per cent., and with power factor 0·70 was 2·9 per cent. The insulation between primary and secondary coils withstood a pressure test of 57,000 volts. The overall dimensions of these transformers are as follows:—Length, 1,600 mm.; breadth, 1,155 mm.; height, 2,005 mm. (fig. 10).

These apparatus take 13 litres of water per minute each for cooling purposes.

The connections of this sub-station, as far as the high-pressure circuits are concerned, are similar to those of the Gromo station. A three-pole emergency switch mounted on poles outside the station allows of the complete isolation of the sub-station. The switch, as will be seen from the illustration, fig. 8, is of the well-known horn break type. As the apparatus is placed in the open, the possibility exists that, when the sub-station is switched out, discharge of current might be produced between the live line and the line entering the transformer station. This could happen through the presence of a foreign body, such as a bird, between the horns, or in very rainy weather. To avoid this sparking across occurring, three contacts have been fixed to the switch, which, when the same is opened, short circuit the lines entering the station and connect them to earth.

The line enters the sub-station in identically the same way as it leaves the primary station at Gromo, and the current passes through the lightning arresters to the high-pressure bus-bars. The leads from the bus-bars pass through three single-pole disconnectors, and three single-pole automatic high-pressure oil switches, to the primary side of the transformers. The secondary side of the transformer is again provided with three-pole disconnectors and two current transformers, one for feeding the overload relay and the ammeter, the other for the relay only. The transformers feed the low-pressure bus-bars at 500 volts. These bus-bars are connected with two feeder circuits for supplying the motors, &c. A large dial voltmeter indicates the bus-bar voltage. Each feeder circuit is provided with a switch and the necessary fuses.

The transformer station is a plain two-storied building. Both floors are sub-divided each into two compartments. On the ground floor at the back the transformers are situated; in the front room, mounted on the separating wall, are the secondary bus-bars with the disconnecting gear and current transformers. (See figs. 13 and 14.)

Immediately above the transformers on the next floor are the high-pressure automatic switches; these are identically the same both as regards construction and *modus operandi* as those installed at Gromo. In the front room there are at present two desk type panels for the high-pressure oil switches and a distributing panel for the 500-volt feeders. The latter carries two 500-volt switches and the necessary fuses. The desk panels are an exact reproduction of the Gromo board, except that only one hand-wheel has been provided, and that the top part, instead of being of cast-iron, is a marble slab. The ammeter is let into the marble and fed from the secondary terminals of the current transformer connected with the secondary bus-bars. (Fig. 12.)

The framework of the 500-volt distribution panel is self-contained and is constructed entirely of iron. All current-carrying parts are protected by iron sheeting against interference. The low-pressure bus-bar voltmeter is mounted on a separate small marble panel.

The feeders from the distributing panels, passing through the upper chamber, leave the building overhead.

On the second floor the 38,000-volt bus-bars have been placed. These are duplicates of those erected at Gromo. The lightning arresters are placed in the next compartment, together with the leading-in arrangements.

This power transmission plant was officially started on July 11th, 1904, and the results obtained were beyond expectation; the plant has also withstood the severe thunderstorms which rage during the hot summer months in the north of Italy. Great credit is due to the enterprising spirit of the contractors and their client in adopting a pressure which has no precedent on the continent of Europe. This installation is another witness to the truth of the economical working and reliability of high-pressure plant, which, thanks to the special devices employed, requires no more attendance than is necessary for a medium-pressure plant. As regards danger to life, this factor has practically been reduced to a minimum by the methodical way in which the plant has been laid out, and by the many protecting devices employed.

In concluding this article, we must express our thanks to the contractors for their courtesy in placing all the above drawings, photographs, and data, at our disposal.

TRAMWAY AND RAILWAY NOTES.

(*Continued from page* 497.)

Metropolitan District.—It is stated that the American Car Foundry Co. is to supply 100 carriages for the London Underground Railway.

New York City.—It was announced, on September 9th, by Mr. William B. Parsons, the chief engineer, that the New York subway would be ready for opening within a few days of October 1st, unless there is "something extraordinary in the way of strikes." On the same date, says a New York correspondent, the deputy chief engineer, Mr. George S. Rice, reported in detail on the safety devices that have been installed in the subway. Provision is made so that two trains on the same line can never travel in contiguous blocks, for the current is cut off automatically, and a train cannot possibly pass a danger signal until there is a clear block ahead. Each signal is lit by means of two incandescent lamps on independent circuits, and the general lighting of the tunnel is also on an independent circuit. At each station, and at every 200 ft. between the stations, there is an emergency switch, by the operation of which the whole of the power current can be cut off from all the rails in case of need. Since the beginning of September a large number of men have been trained in the work of operating the trains, as many as 20 experimental trains being in operation both night and day. These experimental trains have been run on the inner or express metals, and the only difficulties in handling this experimental traffic has been in connection with the switching of the cars for the return trip. There have been prolonged negotiations with the engineering trades unions as to the wages and hours of the motormen. The company has finally conceded payment at the rate of $3·50 (14s. 6d.) per diem, and the men, on their part, have agreed to a ten-hour instead of a nine-hour day. Preference is also to be given to the extent of 50 per cent. of the total force, to employés on the elevated lines, and the men have, more or less reluctantly, accepted the "standard" physical test. A feature of these negotiations which at one time threatened to result in a general strike, has been the presence in New York of a party of 500 "strike breakers," under the generalship of a man named Farley, who makes a business of aiding street-traction companies when threatened by the possibility of a strike. Farley's men have been boarded and lodged at the car-barns at the expense of the Interborough Rapid Transit Co., and have received, in addition, $2 50 (10s.) a day with a promise of $5 a day in the event of their being called upon to operate the cars.

Snowdon Light Railways.—A correspondent writes to the *Times* about this scheme as follows:—"The Light Railway Commissioners have now submitted to the Board of Trade for confirmation an order for the construction of a light railway from the lower end of Llyn Gwynant to Bettws-y-Coed. A considerable controversy has been, and still is, raging in connection with the proposed line. Correspondence has appeared in your columns with regard to it, and a stubborn fight may be anticipated when the Board of Trade inquiry is held. The opposition is based on that clause in the Light Railways Act by which the Commissioners of the Board of Trade are directed to consider any objections made to a proposed railway on the ground that it will injure the natural scenery of the district through which it passes. Apart from this consideration, there is little to be said either for or against the railway. The district it will serve, though large, is wild and sparsely inhabited; but the project is in reality only a part of a large scheme for the opening up of Snowdonia by means of electrical energy, the power being derived from Llyn Llydaw, the dark impressive lake below the summit of Snowdon, which is to be dammed for the purpose."

Later in the article the writer says:—

"Whether the railway, if made, would pay is, of course, a question for the promoters; but when one considers the cost of construction, and how short and how dependent upon weather the tourist season is, one is tempted to doubt the wisdom of those who are backing the scheme financially. It seems even at this eleventh hour worth while to throw out the suggestion that the real interests of the public would be far better regarded by the development of a motor-car service than by the proposed electric railway. For the promoters the initial expenditure would be far less, the working

cost certainly not much greater, and in the off-seasons the cars could be used elsewhere or kept idle with practically no cost to their owners. For the public the means of transit would be cheaper and quicker than at present, and no fresh scar need be made upon the landscape, forming, as it were, an ugly cut across the face of one of Britain's fairest pictures."

South Shields.—It would seem as if the question of the municipalising of the tramways, for the construction of which power has been obtained, would be again prominently before the public. As was stated in our columns, an attempt was made at the last meeting of the Council to take the matter out of the hands of the Committee, but without effect. Now, however, it is stated on the best authority that the Committee which has been conducting the negotiations with the B.E.T. Co. have decided to rescind a resolution, the purport of which was that the company's offer should form the basis for negotiation. The significance of this is that but for formal difficulties a motion would have been adopted recommending the Council to municipalise the system. To put the matter into order it is understood that a notice of motion will be given, and that the question will be discussed at a special meeting of the Council on the 29th inst. This change of front is declared to be due to the finding of some mysterious document bearing on the question of the tender.

Southampton.—At the last meeting of the T.C. a resolution was passed expressing approval of an application to the B. of T. for a prov. order authorising the construction by the Corporation of additional tramways within the county borough.

Southport—Lytham.—The scheme for the construction of a tramway across the Ribble estuary, to connect Southport and Lytham, is being rapidly pushed forward. The contract for the construction of the bridge is said to have been let to a London firm.

Tyrolese Electric Railway.—The first electric railway established in the Tyrol has been opened to traffic between Innsbruck and Fulpmes. It is termed the Stubai Valley Railway, and has been carried out by the Union Electricity Co., of Vienna.

TELEGRAPH AND TELEPHONE NOTES.

Amazon Cable Interruptions.—The note on this subject, which was reproduced in our issue of August 19th on page 304, has drawn a communication from Mr. R. H. Mardock, late superintendent of the Amazon Telegraph Co., which we reprint from the *India-Rubber World* for September:—

"Who Cuts the Amazon Cable?

"In reference to the article published in your August number giving the cause of the many interruptions of the Amazon cable, as explained by Captain Arthur Schindelar, I beg to state that his information is absolutely unfounded and incorrect. The Amazon cable is not purposely cut to aid or abet those interested in rubber, as that gentleman's statement implies, nor has the company any other interest than to keep the cable in working order. Captain Schindelar apparently does not know that anyone cutting a cable or otherwise interfering with telegraphic communication commits a crime, and is liable to a term of imprisonment not less than three years. Imagine having to suborn the officers and crew of the repair ship, the staff at Manaós and Pará (not to mention the intermediate stations), the representative at Rio de Janeiro, and the London directors for nine years!

"Who can be paying for the loss in traffic and the bribes all this time, and who is doing the cutting? It cannot be the rubber merchants, as nearly every house in Pará is represented by a branch in Manaós, and all business is stopped in the latter city during the interruptions. It cannot be the Federal Government, seeing that a subvention is paid by it to assist the company. It cannot be the State Governments, when we know they expended 7,000,000 milreis to open up a road for a land telegraph line, which was constructed and afterwards abandoned on account of the expensive maintenance and interruptions due to falling trees, landslides, &c. It cannot be the company itself, seeing that during the interruptions the traffic is nil and the subvention reduced if the trouble lasts over 90 days, and over £1,000,000 have already been spent to improve the service.

"Will Captain Schindelar kindly say by whom the cable is cut? I am sure the cable company would pay him handsomely for his information. I can testify that up to the end of 1902 the cable company had used every means and device that science can teach in order to maintain permanent telegraphic communication between Pará and Manaós. I defy anyone to prove that the interruptions are not due to natural causes, the principal ones being falling banks, sunken logs, chafing by rocks, and the bed of the river changing on account of the seething current, which in its mad career washes everything before it, the cable becoming buried, making repairs difficult. I wonder if Captain Schindelar has ever noticed the current opposite Parintins and Obidos, or the meeting of the waters below Manaós? Fancy a cable living in that turmoil! *There is no necessity to cut it.* I regret not having met or heard of Captain Schindelar during the 10 years I was in that district, where I know every port on the river between Pará and Manaós, and consequently everyone of importance, especially Americans and English travellers; however, I hope the information he picked up regarding the 'controlling (*sic*) of the rubber trade on the Amazon' was from a better source than that of the cable interruptions.—Yours very truly, R. H. Mardock, late superintendent of the Amazon Telegraph Co., Ltd.; *Concessionaire* for Wireless Telegraphy in Amazonas State; and secretary to the Amazon Commission at the St. Louis World's Fair.

"New York, *August 22nd*, 1904."

The Cable Ship "Monarch."—An explosion occurred on Saturday last on board the G.P.O. steam cable ship *Monarch*, lying off Woolwich Dockyard, by which three men were injured. There is doubt as to how the explosion was caused.

The German-American Cables.—It is announced that the German Atlantic Telegraph Co. has succeeded, after many experiments at Horta, in the Azores, in establishing apparatus which renders it possible, by the automatic insertion of a battery, to so improve the means of transmission, that a direct service takes place between Emden, in Germany, and New York. Previously the messages were taken off at Horta, which is the intermediary station between Germany and the United States, and sent off again, thus causing great strain upon the telegraph staff in consequence of the heaviness of the traffic. As a result of the innovation, however, the duties of the staff have not only been lightened, but the services of some of them have proved to be superfluous, and they are to be transferred to the Carolines and Marianne island. The company now proposes, as a result of the possession of a sufficient number of trained operators, to close the telegraph school which was established at Emden a few years ago.

German-Dutch Telegraphy.—The Deutsch-Niederlandische Telegraphen Gesellschaft, which was formed in July with a share capital of £350,000, has now been entered in the commercial register at Cologne. The object of the company, as mentioned in a former issue, is to acquire and work telegraph and telephone concessions, with special reference to the Dutch Indies.

Imports of Telegraph Cables.—A further shrinkage is noticeable in the importation of foreign telegraph cables and apparatus into this country, the returns for August showing a total of only £3,235 as against £8,381 in August, 1903, and bringing up the aggregate for the first eight months of the current year to £23,666, as contrasted with £42,112 in the corresponding period of 1903.

The Proposed Iceland Cable.—It is reported from Copenhagen that the new cable to Iceland will be completed next year. The connection is to be effected by way of the Shetland isles, as a cable already exists between the latter and Scotland. The expenditure on the new cable, which is being carried out by the Great Northern Telegraph Co., of Copenagen, is estimated at 2,000,000 kroner. It is said that from the landing point of the cable in Scotland, the telegrams to and from Denmark will be forwarded *vid* Newcastle.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Trinidad-Demerara	Aug. 26, 1901	
Dominica-Martinique	May 7, 1902	
St. Lucia-Martinique	May 7, 1902	
Cayenne-Pinheiro	Aug. 13, 1902	
Reissa-Issa (Yemen)-Camaran	Oct. 22, 1902	
Tarifa-Tangier	Jan. 18, 1904	
Closed { Vladivostock-Nagasaki	Feb. 9, 1904	
Closed { Port Arthur-Chefu	Mar. 9, 1904	
Paramaribo-Cayenne	July 13, 1904	
Cape Haitien-Mole St. Nicholas	Aug. 20, 1904	
Bundaberg-Gomen (New Caledonia)	Aug. 30, 1904	
Marseille-Barcelona	Sept. 16, 1904	
Landlines.		
Cartagena-Baranquilla	Dec. 8, 1900	
Puerto Bairros	July 28, 1902	
Seoul-Masampo	Feb. 18, 1904	
Seoul-Gensan	Feb. 18, 1904	
Anju-Ping-Yang	Feb. 25, 1904	
Ninguta-Vladivostock	March 2, 1904	
Caimanera-Santiago	June 15, 1904	

Wireless Telegraphy.—It is reported by Reuter that overland communication has been successfully established by wireless telegraphy between St. Louis and Chicago, a distance of 300 miles, on the de Forest system.

Electrolytic Preparation of Sodium from a Mixed Bath of Sodium Hydroxide and Carbonate.—M. le Blanc has published (*Zeits. Elektrochemie*, 1904, x., 568) an account of an investigation carried out by C. F. Carrier, jun., into the method suggested by H. Becker for obtaining metallic sodium by electrolysing a fused mixture of sodium hydroxide (caustic soda) and sodium carbonate. Carrier finds that when such a mixture, containing up to 66 per cent. of carbonate, is electrolysed at temperatures between 260° and 630° C., with current densities up to 2·5 amperes per square centimetre, no carbon dioxide is produced. The process, therefore, will not work in the form given to it by its original inventor, and it is really nothing but an inferior kind of Castner process, in which hydroxide is used alone. Moreover, carbon dioxide is not liberated from aqueous solutions of sodium carbonate containing hydroxide at a temperature of 90° C. and a current density of 0·6 ampere, until the sodium hydroxide is neutralised.

CONTRACTS OPEN AND CLOSED.

OPEN.

Aberdeen. — September 27th. Twenty top-deck car covers, for the Tramways Committee. See "Official Notices" September 2nd.

Bangour Village.—September 28th. The Edinburgh District Lunacy Board invites offers for the following works:—(1) Electric wiring and cables; (2) telephone installations; (3) electric bells, required in connection with certain buildings erected and to be erected at Bangour. The specification may be obtained from the architect, Mr. H. J. Blanc, 25, Rutland Square, Edinburgh.

Barnes.—September 27th. The U.D.C. invites tenders for the wiring of the Isolation Hospital, Mortlake. Particulars at the Council Offices, High Street, Mortlake.

Brighton.—October 10th. Advertising rights for the electric cars. See "Official Notices" to-day.

Bury.—September 26th. The Guardians want tenders for electric wiring, bells, and telephones for the new hospital buildings. Mr. G. R. Peers, 16, John Dalton Street, Manchester, consulting engineer (specifications, one guinea).

Edmonton.—September 27th. The U.D.C. invites offers from companies willing to carry out its electric lighting provisional order. See "Official Notices" August 26th.

France.—September 29th. The municipal authorities of Paris are inviting tenders, until September 29th, for the supply and erection of a gas engine and dynamo of a capacity of 7 KW. at the municipal electric lighting station at the Square Saint Pierre. Particulars may be obtained from, and tenders are to be sent to, l'Hotel de Ville, Paris.

Hull. — September 30th. The Corporation invites tenders for the wiring and fitting of Beverley Road Baths. Forms of tender at the City Engineer's Office.

Ilford.—October 4th. Balancer and switchboard panel; reversible booster and panel, for the U.D.C. See "Official Notices" September 16th.

Leyton.—September 23rd. Electric wiring and fittings for Newport Road School. See "Official Notices" September 2nd.

London.—October 4th. Three electric car traversers for the L.C.C. See "Official Notices" August 5th.

London.—October 4th. The L.C.C. wants tenders for centrifugal and other pumps for Greenwich power station. Particulars from Mr. G. L. Gomme, County Hall, Spring Gardens, S.W.

Manchester.—October 4th. Ampere-hour and watt-hour meters for the Electricity Department. See "Official Notices" to-day.

Middlesex.—October 12th. The Light Railways Committee of the Middlesex County Council invites tenders for the work and materials required in the construction of the permanent way (for electric traction), bridge work, and road widenings connected with the following light railways:—

Railway No. 3.—A line of double track, with junctions, cross-overs, &c. (and contingent works of road widenings and new bridge work), to be laid along Station Road and Buckingham Road, in the urban district of Wood Green. The line will have a total length of about 4 furlongs 8 chains.

Railway No. 6.—A line of double track, with junctions, cross-overs, &c. (and contingent works of road widenings and new bridge works), to be laid along High Street, Harlesden, and Harrow Road, in the urban districts of Willesden and Wembley. The line will have a total length of about 1 mile 3 furlongs 5 chains.

Philippopoli.—October 2nd—15th. The Municipality is inviting proposals for the installation of electric lighting and tramways in the town. A copy of the official announcement in French will be found in the *Times* for September 5th. M. Penkoff is the chief of the technical section.

Richmond.—October 5th. Pumping machinery and electric motors for the Sewerage Board. See "Official Notices" September 16th.

Servia. — October 2nd. Tenders are invited until October 2nd, by La Société Oratschar et Kablar, at Tchatschak, Servia, for the supply of two sets of turbines and dynamos for their central electric lighting and power station.

Salford. — October 6th. Lead-covered cables for the Electricity Committee. See "Official Notices" September 16th.

Shanghai.—March 31st, 1905. The Board of Trade have received through the Foreign Office a copy of a telegram from the British commercial agent in Shanghai to the effect that tenders are invited by the municipality of that city for the construction and working of 24 miles of electric tramways on the trolley system, double or single. Conditions, plans, &c., on application to Messrs. Pook & Co., agents for the municipality of Shanghai, 63, Leadenhall Street, E.C.

Spain.—October 12th. The Municipal Authorities of Espinar (province of Segoria) are inviting tenders for the concession for the electric lighting of the town. Particulars may be obtained from, and tenders are to be sent to, El Secretario del Ayuntamiento de Espinar (Segoria).

Tynemouth.—September 30th. One 600-KW. steam dynamo for the Corporation. See "Official Notices" September 9th.

CLOSED.

Bermondsey.—The B.C. received the following tenders on Tuesday for installing the electric light in the staircases and courtyards of the Fulford Street dwellings:—

Sunderland & Co.	(accepted)	£138 0
E. Probert & Co.		165 15
J. Defries & Sons, Ltd.		176 10
A. H. Marshall & Co.		189 10
A. W. Penrose & Co.		198 0
P. H. Allin & Sons		215 0
The Laxnot Lighting Co.		238 9
E. P. Allam & Co.		254 12
Salisbury Electrical Engineering Co.		259 10
Ward Bros.		270 12
Gibson & Co.		298 10
Hargrave & McCraight		300 11
E. Newbald & Co.		320 16
Sweet Bros.		510 0
J. Cardwell		550 0

Carnarvon.—The Hart Accumulator Co. have received the contract for a storage battery (256 of their standard lighting type cells) for the electricity works.

Chelsea.—The Guardians received 24 tenders for wiring the wards of the Infirmary. These were as follows:—

Coleby & Co.	£585	10 0
Warren Smith	642	0 0
Bolton, Fane & Co.	652	0 0
Patrick McCarthy	475	0 0
William Seymour	547	0 0
Wells, Raynor & Co., Ltd.	399	0 0
Buckley & Beach	545	0 0
G. E. Taylor & Co.	480	0 0
Mark Wiedhofft	366	0 0
John Boulting & Sons	403	10 0
E. P. Allam & Co.	490	0 0
Ernest Probert & Co.	511	0 0
Donnisson, Sillem & Co.	618	0 0
Thos. Potter & Sons	525	0 0
Thos. Clarke & Co.	481	4 6
C. Mickleborough (accepted)	366	17 6
District Electric Co., Wolverhampton	380	0 0
Wm. Wing	399	4 0
Lee & Warren	375	0 0
Fryer & Co.	508	0 0
Percy Turner	995	0 0
Smitham & Page	552	8 0
Engineering Co., York Place	537	9 0
Farringdon Electric Wiring Co.	530	3 0

Colne.—The T.C. has accepted the tender of Messrs. Körting Bros. for the supply of piping and valves to the electricity works, at £145.

Shoreditch.—The B.C. received on Tuesday the following tenders for 2,430 yds. of cable:—

British Insulated and Helsby Cables, Ltd. (accepted)	£590	0
Siemens Bros. & Co., Ltd.	592	15
W. T. Henley's Telegraph Works Co., Ltd.	597	10
W. T. Glover & Co., Ltd.	598	0

FORTHCOMING EVENTS.

September 27th, 28th and 29th.—Municipal Tramways Association of Great Britain. Annual Conference to be held in Liverpool. Full particulars were given in our "Notes" in September 9th issue.

NOTES.

Electric Headlights on Indian Trains.—Some of the new locomotives brought into service by the North-Western Railway of India are fitted with powerful electric headlights of American manufacture. *Indian Engineering* says that the equipment consists of a turbo-generator mounted on top of the boiler barrel immediately in rear of the engine dome, and two projectors mounted on the head of engine and rear of tender respectively. The projectors are capable of movement over a wide arc both horizontally and vertically by a quadrant and a screw elevating gear, both of which are operated from the cab of the engine. The reflectors are so shaped as to throw a parallel beam of light which, under favourable circumstances, will illuminate a straight track to a distance of ¾ mile. The lamp is of a peculiar pattern, the negative electrode being of copper, while the upper is a solid carbon. The turbo-generator is a very compact apparatus, a small turbine being coupled through a flexible coupling to a four-pole generator furnishing direct current at a normal pressure of 35 volts. The lamps are controlled by a double-pole switch placed in the cab, the connections to the generator and lamps being run in wrought-iron tubes.

Brush Athletics.—Everything must have a beginning, and so it came to pass that on Saturday last the Brush Co. indulged, for the first time, in athletic sports. The London staff travelled down to Loughborough by the 10 o'clock train from St. Pancras, and the afternoon was devoted to the friendly rivalry of the London and country employés of the Brush Co., and a small contingent of B.E.T. men, on the Rugby Football Field, Meadow Lane. On the arrival of the train, a visit was paid to the various departments of the works, and here, also, the London visitors were entertained at an informal luncheon. The sports included a 100 yards scratch race, scratch walking race, 120 yards handicap flat race, a relay race, 440 and 880 yards handicap flat races, 100 yards handicap flat race for veterans, 120 yards handicap hurdle race, tug-of-war, and tilting (not kicking) the bucket.

The exigencies of space will not allow us to enter into much detail of this very successful gathering, but we cannot refrain from mentioning the veterans' race in which Mr. George Offor, so well known in municipal and private company electrical circles, romped home an easy winner both in his preliminary heat and in the final. Mr. Offor is 77½ years of age, and a boy at that, and with an utter contempt for jersey, racing drawers, and shoes, he merely divested himself of coat and hat, and accomplished a performance of which "Sunny Jim" might well have been proud. The fine running of Mr. J. E. Schofield in several events, but particularly in the 880 yards race, deserves special praise. Mr. Schofield is a born athlete, and the grace and lightness of his splendid stride created a marked impression upon competent judges of running. Great diversion was caused by the various competitors for tilting-the-bucket prize, the majority getting a thorough ducking, to the intense amusement of the large gathering of spectators.

The weather was simply charming, and to add to the pleasure of everybody on the ground, the band of the Loughborough Rifle Volunteers, under the bâton of Sergeant H. G. Lovett, bandmaster, discoursed that which has charms to soothe a savage breast.

A pleasing feature of the admirable arrangements for the day's enjoyment was the inclusion amongst the London party of the ladies of the town staff, and another point was the remarkable punctuality with which every event was got off. Indeed, such commendable regard to time-keeping is a rare thing at athletic meetings, and the management deserves the highest praise, especially as this was the first attempt at anything of the kind.

The prizes were presented to the winners by Lady Vaux of Harrowden, and amongst the company present were Lord Vaux of Harrowden, Messrs. W. L. Madgen, A. B. Blackburn, B. Broadhurst (the genial secretary to the company), and J. H. Pritchard, who acted as stewards; J. J. Steinitz, P. W. Mcdougall, judges; T. C. Elder, referee; E. E. Cook, starter; J. S. Turner, secretary of the Sports Committee, and many others.

Mr. Turner, we believe, had much to do with the highly creditable programme, and he and everybody else connected with the meeting may be heartily congratulated on a success as great as it was probably unexpected, and we shall be surprised if the Brush Athletic Sports do not become an annual event. We cannot too strongly urge the desirability of such gatherings; to the employés there is something to look forward to and to train for, and whatever the good feeling which exists between employers and employed, such friendly intercourse as was witnessed in the sporting field last Saturday, can only be productive of greater good to both.

Wire-drawing of Steam.—A correspondence is in progress in a contemporary in connection with the use of high pressure steam reduced through valves to the working pressure suitable for the engines. Undoubtedly wire-drawing does produce a certain calculable amount of superheat. If the calculable amount of superheat is not secured the inference is that the steam was wet, and in place of superheat only drying has been performed by the wire-drawing. As evidence of the value of this wire-drawing, a case came under our notice where the owner of an engine that could not safely take high pressure steam, awoke to what he thought was the folly of working the boiler at a pressure higher than necessary. But on reducing the boiler pressure it was found that the boiler would no longer do the work, and it became necessary again to load up the safety valve and work by wire-drawing, which gave steam at least dryer than that turned out by the boiler when under low pressure. High pressure steam leaves a boiler with less whirl and eddy, and carries off with it less water. Steam pipes if hotter may be smaller and better covered, and economy must result. Wire-drawing steam is economical if it is not possible to work the engines at the full boiler pressure, but given engines capable of taking high pressure steam, it would not then be economical to work the engines at a low pressure just for the sake of wire-drawing.

A Southwark Alderman on Electrical Engineers.—At the Borough Council meeting on Wednesday evening last week, some remarkable opinions on electrical engineers were expressed by Alderman Boyd. It will be remembered that the services of the late electrical engineer to Southwark Borough Council, Mr. Blaikie, were dispensed with by this Borough Council in a manner which caused much severe comment in the electrical world. On Wednesday evening the Electric Light Committee recommended that advertisements be issued for a chief engineer and manager of the electric light undertaking at a salary of £300 per annum, rising by annual increments of £20, to a maximum of £400 per annum. A long discussion arose on this recommendation.

Councillor Chell moved that the matter be referred back for further consideration. He argued that they did not want an electrical engineer to manage the concern, but a commercial man who would go out and canvass for customers, whilst a mechanical man should manage the electric light station.

Alderman Boyd warmly supported the proposition of Councillor Chell. They did not want an electrical engineer, he said, with a lot of letters after his name, but a good business man to manage the concern outside the station, and a smart mechanical engineer to manage the station itself. Properly speaking, he said, there was no such thing as an electrical engineer. Any person of ordinary intelligence could read up in a month all that an electrical engineer knew. There was nothing in it. It was all a lot of theory. What they wanted was a good mechanic to supervise the station.

Councillor Attenborough said he did not think it was any good for the Council to issue advertisements for a qualified electrical engineer. The Council had treated the late chief of their electric lighting department, Mr. Blaikie, so disgracefully, that no member of the Institution of Electrical Engineers would be likely to apply for a post under such a Council.

After a long debate, the Committee's recommendation to advertise for a chief engineer and manager was carried by a large majority.

Hitherto we had supposed that the Corporation of Wigan stood unique amongst municipal authorities in point of arrogant conceit and contempt for knowledge beyond its own limited capacity; we must now class the Southwark councillors in the same category, with the honourable exception of those who protested against such a display of incompetency as was exhibited at the meeting. On reference to our issue of August 29th, 1902, p. 355, it will be seen that at Wigan the councillors wanted "*a man they could all talk to, and tell him if things were not going right*"; they regarded electrical engineering as "an inexact science" which had been in vogue for little more than three or four years, and "if there was any great science in electricity, it was something that was unknown." "They would practically do away with the whole of the electrical engineering experience required."

While such deplorable opinions might be excused in Wigan, it is impossible to be equally lenient towards the Metropolitan Borough Council of Southwark, representing a population of nearly a quarter of a million. Its recent unjust and selfish action in compelling Mr. Blaikie to resign—not because any fault was found in him, but in order to save its own face—will be fresh in the memory of our readers; and the present proceedings are, no doubt, only such as might be anticipated from such a body. The comparative want of success of the electric light undertaking needs no further explanation.

Appointments Vacant.—Chief engineer and manager for the Southwark electric lighting undertaking (£300, rising to £400); lecturer and demonstrator in electrical engineering for New Zealand (£300); junior assistants for Dundee; switchboard attendant for Leigh (20s.); shift engineer for Blackburn (£2); the Pontypridd D.C. is going to appoint a resident electrical engineer; the Agent-General for the Cape of Good Hope invites application for the appointment of a mechanical and electrical engineer to his department at £800 per annum.

South African Notes (from our Durban correspondent).—*Pretoria (Transvaal).*—At a Town Council meeting on August 22nd, it was decided to purchase outright the entire system of the Pretoria Lighting Co., for the sum of £115,000, repayable in debentures not later than 30 years, at 5 per cent. interest. Certain shareholders of the company also undertook to advance the sum of £20,000 for extensions and development.

Another correspondent writes:—

Port Elizabeth.—At a meeting of the T.C., a scheme for lighting the town by electricity was adopted. It is estimated that this departure will cost £90,000.

Vryheid.—The Local Board will meet shortly to consider the respective applications of Mr. L. Warner and Mr. E. Christensen for the electric lighting concession for the town.

Kroonstad.—At a recent meeting of the T.C., electric light regulations were laid on the table and passed, the cost of a connection to a house not more than 30 ft. from the street to be £2, and the charge for light fixed at 1s. per unit, with a maximum charge of 2s. and 6d. per month for every group of lights of 8 C.P.

Victoria Falls.—The erection of the electric cable-way over the Zambesi immediately below the Falls, preparatory to the construction of a bridge across the chasm, is now completed, and was first put in operation on July 28th last. Electrical energy operates a 4-ton "Blondin" electric "rope-walker," traversing a 2¾-in. steel cable. An iron car, weighing 2 tons, was attached, and after a preliminary trip, Lady Lawley, Lady Farrar, and party crossed over, the first of the unofficial element to utilise this mode of transport across the Falls.—*Cape Times.*

The Electro-Harmonic Society.—The hon. secretary, Mr. W. E. Lane, has issued a notice respecting the arrangements for the nineteenth season. The concerts will be held in the King's Hall, Holborn Restaurant, on the following dates:—

Smoking Concerts.—Fridays, October 14th and December 9th, 1904, and January 20th and March 24th, 1905.

Ladies' Nights.—Fridays, November 11th, 1904, and February 24th, 1905.

Mr. Augustus Stroh, who has acted as hon. treasurer to the Society since its commencement, has resigned this office on the ground of advancing years. Mr. Robert Kaye Gray has accepted the position of hon. treasurer in succession to Mr. Stroh. Mr. Lane asks that all communications for him respecting the Electro-Harmonic Society shall be addressed to him at 123, Cannon Street, E.C.

2,000 KW. Rotary Converters.—The New York Edison Co., will in a few days' time, begin operating the first of four new 25-cycle, 6-phase, 270-volt, 2,000-KW. rotary converters, built by the General Electric Co., at Schenectady, N.Y., to the specifications of the New York Edison Co.'s engineering staff. These converters are the largest ever made by the General Electric Co. The largest rotary converters hitherto installed by the New York Edison Co. are of 1,000 KW. output.

The Diatto Surface Contact System.—In the course of a statement issued to the shareholders, the Paris General Traction Co. announces the abandonment of the working of the Diatto surface contact system on the tramways. The lines have proved a financial burden to the company, and the sacrifices made have only been entered in part, in the accounts for 1903, while the balance will be written off in those for 1904 and 1905.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the power station or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*]

Central Station Engineers.—The Falkirk T.C. has appointed Mr. THEODORE MCDOUGALD, of the Corporation Electricity Department, Dundee, as first assistant electrical engineer for the burgh at £100 per annum.

The Paisley T.C. has agreed to increase the salary of Mr. PARKINSON, the electrical engineer, by £100, making it £400, with free house, &c.

Mr. F. A. WATKINS, assistant engineer at the Ipswich Corporation electricity works, has resigned his appointment for family reasons. His address is 5, Greave's Place, Hunslet, Leeds.

The Portsmouth T.C. by a majority adopted the Electric Lighting Committee's recommendation that the salary of Mr. FOALE, the engineer and manager of the electric lighting station, be increased from £325 per annum to £400 per annum forthwith, and that he be informed that any future increase will depend entirely on the success of the undertaking.

Radcliffe U.D.C. has appointed Mr. GEO. NUTTALL as charge engineer at the electricity works.

Ilford U.D.C. has appointed Mr. J. R. MYERS as station superintendent at the electricity works at an annual salary of £150.

Mr. E. J. WILLIAMS, chief assistant engineer at Hawick, has been appointed resident engineer at Inverness.

Electric Tramway Officials.—Newport (Mon.) T.C. has decided, by 18 votes to 11, to request Mr. G. H. WINDSOR, tramways traffic inspector, to resign his position in consequence of the friction between him and the electrical engineer, Mr. COLLINGS BISHOP.

General.—We regret to learn from our American exchanges, which are to hand this week, that Mr. C. C. HASKINS died at Chicago recently. Mr. Haskins was a writer on electrical subjects, and an inventor in the domain of telephony. He was 77 years of age. *Electricity* of New York says:—"In 1844 he is said to have sent the first telegraphic message that ever passed between two countries, wiring it from Buffalo to Queenstown, Canada. His most notable achievement was evolving the multiple switchboard, now used for telephones all over the world, which makes it possible to operate any number of lines from the same exchange."

On Monday the Education Committee of West Ham Corporation decided to appoint (subject to the usual sanction) Mr. P. R. FRIEDLANDER, late of the staff of Messrs. Crompton & Co., of Chelmsford, assistant lecturer in electrical engineering to the Technical Institute. There were eight candidates. The salary is £200 a year. Mr. J. COXON, A.I.E.E., chief assistant in the lighting and power department of the General Post Office, was provisionally appointed instructor in electric wiring.

Mr. HY. T. BROUGHALL, of Birmingham, has announced his intention of leaving next week, per ss. *Cymric*, for a visit to the United States. In his absence correspondence will be attended to by Mr. Fred. Woolley, 39, Darwin Street, Birmingham.

Mr. JOSEPH BASTICK, electrical engineer and acetylene expert, late of Garston, Liverpool, has taken up the position of resident consulting engineer to Messrs. Hewson & Co., carbide manufacturers, Askeaton, Co. Limerick.

NEW COMPANIES REGISTERED.

Electrical Contractors' Association (Incorporated) (82,063).—This company was registered on September 16th, with an unlimited number of members, each liable for £1 in the event of winding up, to promote and protect the trade of electrical engineering in Great Britain, and to take over (so far as the same may be legally vested in this Association) the property of the unincorporated association known as the National Electrical Contractors' Association. The word "Limited" is omitted from the title by licence of the Board of Trade. The first subscribers are:—W. R. Rawlings, A.M.I.E.E., 82, Gloucester Road, S.W., President of National Electrical Contractors' Association; J. McDermott, J.P., A.M.I.E.E., Spain House, Ashton-under-Lyne; E. C. Wallis, M.I.E.E., 27, Ash Grove, Hyde Park, Leeds; E. L. Berry, A.M.I.E.E., Lyric Chambers, Whitcomb Street, W.C., President, London Electrical Contractors' Association; A. R. Phipps, 147, Oxford Street, W., Past President London Electrical Contractors' Association; A. E. Porte, M.I.E.E., 61, Dawson Street, Dublin; and T. Wright, 136, Bothwell Street, Glasgow. The management is vested in a Central Board, consisting of not more than 40 members.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Electric and General Investment Co., Ltd. (31,506).—This company's annual return was filed on July 25th, when the entire capital of £200,000 in 20,000 ordinary, 100 founders, and 19,900 preference shares of £5 each had been taken up. £5 per share has been called up on the founders and preference, and £1 per share on the ordinary shares, resulting in the receipt of £120,000. Mortgages and charges: Nil.

Sunbeam Lamp Co., Ltd. (Gateshead) (25,498).—Issue on September 1st of £100 debentures, part of series created January 28th, 1904, to secure £10,000, charged on the company's undertaking and property, present and future, except uncalled and unpaid capital. No trustees. Previously issued of same series: £9,400.

Northampton Electric Light and Power Co., Ltd. (28,640).—Issue on August 25th of £100 debentures, part of series created June 3rd, 1896, securing not more than two-thirds of the subscribed share capital for the time being, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series: £32,100.

Utility Co., Ltd., Britannia Electric Lamp Works, South Tottenham (77,903).—A memorandum of satisfaction in full of debentures dated January 25th and April 26th, 1904, securing £40 and £150 respectively, has been filed.

Exchange Telegraph Co., Ltd. (6,152C).—This company's annual return was filed on August 23rd, when 8,032 "A" and 16,200 "B" shares had been taken up out of a nominal capital of £246,250 in 8,125 "A" and 16,500 "B" shares of £10 each; £9 per share has been called up on 6,000 "A" and £1 per share on 2,023 "A" shares, resulting in the receipt of £56,023; 16,200 "B" shares are considered as fully paid; £16,184 (£8 per share) is considered as paid on 2,023 "A," and in addition thereto £102 was considered as paid on 102 "A" shares which have been forfeited. Mortgages and charges: Nil.

Burnand Transformer, Ltd. (Manchester) (73,049).—A memorandum of satisfaction in full of 10 debentures, dated December 3rd, 1903, securing £1,275, has been filed.

Telephone Co. of Egypt, Ltd. (17,824).—A memorandum of satisfaction in full of debentures, dated April 29th and May 20th, 1903, securing £5,000, has been filed.

ELECTRIC TRAMWAY ACCOUNTS.

Southport Corporation Electric Tramways.

THE returns of the Southport tramways department for the past year show that the department has at any rate, considerably improved on its previous year's working, although that improvement did not succeed in eliminating a loss on the whole. Still, with improved income and decreased working and financial charges per car-mile, the deficit has been reduced from some £1,200 to £340, and for this all credit is due to the management.

The returns include about 12,000 car-miles run on the company's lines and payment for energy consumed there. Mr. Thos. J Kendrew is the tramways manager.

GENERAL STATEMENT.

For 12 months ending	Mar. 31, 1904	Mar. 31, 1903.
Length of route	8 miles	8 miles
Total length of track	10·7 „	10·7 „
Number of cars in use	15 (av.)	14 (average)
Car-miles run	431,019	418,824
Passengers carried	3,839,208	3,535,434
Capital expended to date	£118,364	£116,882
Traffic receipts	£17,304	£16,179
Total „	£17,646	£16,387
Working expenses	£10,986	£11,231
Gross profit	£6,660	£5,156
Income per car-mile	9·82d.	9·40d.
Working expenses per car-mile	6·12d.	6·44d.
Interest and sinking fund per car-mile	3·90d.	3·65d.
Total expenses per car-mile	10·02d.	10·09d.
Profit or loss per car-mile	—·2d.	—·69d.
Cost of energy per car-mile	1·74d.	1·87d.
Average fare per passenger	1·082d.	1·098d.
Average fare charged per mile	·79d.	·79d.
Revenue per mile of route	£2,206	£2,048
Expenditure per mile of route	£1,373	£1,408
Total units used	492,261	458,472
Units used per car-mile	1·17	1·16
Percentage of working ex'es to receipts	62 %	67 %

PROFIT STATEMENT.

	1904.
Interest	£3,803
Sinking fund	3,198
Deficit	−341
Gross profit	£6,660

East Ham Corporation Tramways.

THE second year's working of this undertaking, extended since the previous report, has resulted in a considerable development of traffic and receipts.

Roughly, 13 millions of passengers, as against 10 millions in 1903, were carried, and this represents an increase from 15·3 to 16 passengers per car-mile. The traffic revenue shows an increase, and this is only partly counterbalanced by the increased average operating costs.

After meeting all charges, some £2,898 remained as a surplus, and this was disposed of for legal expenses, repayment of preliminary capital expenses, a contribution to reserve and renewals, and repayment of initial expenses.

It will be noted that energy expenses are above the normal, and that cheap fares still have the effect of reducing the average revenue per passenger to an abnormally small amount. Mr. W. C. Ullmann is the engineer and manager.

GENERAL STATEMENT.

For 12 months ending March 31st.	1904.	1903.
Length of route...	8	7
Total length of track	11·4	10·5
Average number of cars in use ...	—	30
Car-miles run	807,002	650,224
Passengers carried per annum... ...	12,950,269	9,971,337
Capital expended to date	£135,591	£127,265
Traffic receipts	£34,312	£25,341
Total receipts	£35,301	£26,099
Working expenses	£24,262	£18,634
Gross profit	£11,039	£7,465
Income per car-mile	10·50d.	9·63d.
Working expenses per car-mile ...	7·22d.	6·88d.
Interest and sinking fund per car-mile	2·42d.	2·09d.
Total expenses per car-mile	9·64d.	8·97d.
Profit or loss per car-mile	+·86d.	+·66d.
Cost of energy per car-mile	2·00d.	2·02d.
Average fare per passenger	·63d.	·62d.
Revenue per mile of route	£4,413	£3,728
Expenditure per mile of route ...	£3,033	£2,666
Total units used	920,696	656,125
Units used per car-mile	1·14	1·01
Percentage of working exp's to receipts	68 %	71 %

PROFIT STATEMENT.

	1904.
Interest on loans	£4,856
Sinking fund...	3,285
Surplus on year's working	2,898
Gross profit	£11,039

CITY NOTES.

Ferranti, Ltd.—Rearrangement Scheme.

BY order of the Court, the liquidators of Ferranti, Ltd., have convened meetings of (1) the unsecured creditors, (2) preference shareholders, and (3) holders of first mortgage debenture stock, to be held at Winchester House, E.C., on Thursday, September 29th—(1) at 11 o'clock, (2) at 12.30 o'clock, and (3) at 1 o'clock. The following is a summary of the scheme of arrangement which will then be submitted:—

A new company will be formed, known by the same title as the old company—Ferranti, Ltd.—and it will have a nominal capital of £130,000 in 60,000 6 per cent. cumulative preference, 60,000 ordinary and 10,000 deferred shares, all of £1 each. Also a first mortgage debenture stock of £100,000 bearing 5 per cent. interest, and a second mortgage debenture stock of £30,000 also at 5 per cent.

The holders of first mortgage debenture stock in the old company will receive a similar amount of first mortgage debenture stock in the new company, and the holders of old second mortgage debentures will accept a like amount of new second mortgage stock.

The unsecured creditors of the old company will receive paid-up preference shares of the new company for the nominal amount of their debts in satisfaction of the latter.

The preference shareholders of the old company will be entitled to fully paid-up ordinary shares in the new company of *half the nominal amount* of their present holding in the old company.

The 10,000 deferred shares are to be allotted to Mr. S. Z. de Ferranti, in consideration of which he will "covenant to serve the new company for a term of years to be agreed at a salary of £500 per annum, and give the company the benefit of his inventions in switch and meter work hereafter to be made, and all improvements of such inventions and of existing patents and inventions, which are the property of the company." These deferred shares will not rank for dividend until 7 per cent. has been paid on the new ordinary capital.

The new company will pay all arrears of interest on the first and second debenture stocks due up to October 1st, 1904.

It is pointed out that the assets of the old company being wholly insufficient to pay any more than a small proportion of the nominal amount due on the preference shares, *the ordinary shareholders of the old company have no interest in its assets* or in this scheme.

It is proposed that if the scheme outlined above is approved, and is duly sanctioned by the Court, that the liquidation proceedings shall be withdrawn, and that the receivers and the provisional and voluntary liquidators shall be discharged, except so far as may be necessary for carrying out, or for determining any question which may arise in the carrying out of, the scheme.

The first directors of the new company will be Andrew Wilson Tait, Basildon House, Moorgate Street, E.C., chartered accountant; Arthur Whittaker, 3, York Street, Manchester, chartered accountant; John Macdonald Henderson, 2, Moorgate Street Buildings, E.C., chartered accountant; and Mr. S. Z. de Ferranti.

Mr. Henderson is the liquidator of the company, and Messrs. Tait and Whittaker were, in September, 1903, appointed joint receivers and managers for the first debenture stockholders.

Dick, Kerr & Co., Ltd.

THE report for the year ended June 30th last, to be submitted to the meeting on 27th inst., states that the profits earned amount to £84,170. Out of this had to be paid debenture and loan interest and trustees' fees, and there has been reserved the sum required to provide for the premium payable on the redemption of the present debenture stock. These items absorb £14,441, leaving £69,729, to which must be added the profits brought forward, £35,544, making a total of £105,274 available for appropriation. After paying the dividend on the preference share capital, it is proposed to carry one-fifth (£10,285) of the remaining profits to reserve, as required by the trust deed securing the debentures, and also a further sum of £10,765 to bring it up to the limit prescribed by the deed: to pay a dividend of 10 per cent. on the ordinary shares, and to carry forward the balance of £39,922. During the past year the company has completed, amongst other important contracts, the electrification of the Lancashire and Yorkshire Railway between Liverpool and Southport, and the Hong Kong and Mandalay electric tramway systems, and are at present busily engaged in Tokyo, Singapore, Bangkok, and other places both at home and abroad. The directors call the attention of the shareholders to the fact that the reserve to be set aside under clause 31 of the trust deed securing the debenture stock has now reached the limit of £150,000 prescribed by that deed. Mr. Claud T. Cayley having retired from the chairmanship of the company, Mr. John Kerr, M.P., has been elected in his place, and Mr. Cayley has accepted the position of deputy-chairman. The directors regret that in consequence of ill-health Mr. G. W. Carr has resigned his position as secretary of the company, and they have appointed Mr. Frank Mott in his place.

[The dividend last year was 10 per cent., but there was also a bonus of 5 per cent.]

Buenos Ayres Electric Tramways Co. (1901).

THE report for 1903, presented at the meeting held in London on Monday, states that gross receipts for the year from the sections opened for traffic amounted to £18,282, and the working expenses, inclusive of London administrative charges, to £15,913, showing a net profit of £2,506. Part of the amount required for the debenture interest to date had been provided by the vendor syndicate. At the commencement of the year the line was working up to Maldonado (5·6 miles) and a further section from Gascon to Triunvirato (1·5 mile) was opened in June last. On October 22nd, 1903, the Chacarita section (three miles) was also opened, giving an immediate and encouraging increase in receipts. The construction of the remaining sections—namely, the Belgrano and Flores sections—was proceeded with, but as these were not completed during the year, no benefit accrued to the company therefrom. The business of the company was greatly hampered by the construction and heavy repairing work which was proceeded with throughout the whole year, not only on the new lines, but also on the old lines taken over, often necessitating the running of the tramway on a single track, and the results of the year cannot therefore be considered as giving any indication of the company's real earning capacity. Since the end of the financial year—namely, May 26th, 1904—a further important section (the Belgrano section) had been opened for traffic. A concession had been applied for and granted by the municipality, authorising an extension of this section through the streets near the station of the Central Argentine Railway. The construction of this was being rapidly proceeded with, so that it may be opened for traffic early in the ensuing summer season. The

Flores section, which, with the sanction of the municipality, had been modified from the route originally authorised, was opened for traffic on August 23rd, 1904. A concession had also been granted to the company for an extension of this route, the work to be finished at any time within three years from September 23rd, 1903. Since December 31st last the traffic receipts were showing fair increases. Colonel Oldham resigned his seat on the board in November, 1903. Mr. Charles Lock was elected a director to fill the vacancy.

Mersey Railway Co.

THE directors' report for the half-year ended June 30th, 1904, to be submitted to the meeting to be held at Worcester House, Walbrook, on Tuesday, September 27th, at 12 o'clock noon, reads:—"The train mileage run during the half-year was 411,683 miles, as compared with 218,308 (steam, 103,687; electric, 114,621) during the corresponding half-year of 1903. The number of passengers conveyed during the six months ended June 30th, 1904, has been 4,499,147, as against 3,201,644 for the corresponding period of 1903, exclusive of season ticket holders. The total receipts from all sources for the half-year have been £40,918 1s. 7d., as compared with £32,277 15s. 7d. for the corresponding period of 1903. The working expenses, exclusive of the exceptional charges for pumping, ventilation, and lifts, have been £29,751 13s. 10d., equal to 72·71 per cent., as against £27,375 10s. 4d., equal to 84·41 for the corresponding six months. These exceptional charges for pumping, ventilation, and hydraulic lifts, for the past six months amounted to £3,839 9s., equal to 9·38 per cent., as compared with £4,686 2s., or at the rate of 14·52 per cent. for the corresponding period of 1903. Your directors have pleasure in reporting that the questions between the company and the British Westinghouse Electric and Manufacturing Co., Ltd., have been satisfactorily settled since the close of the half-year."

Official Announcements re Companies.

THE following companies are to be struck off the register within three months unless cause is shown to the contrary:—

Clayton Engineering and Electrical Co., Ltd.
Electrical Automatic Loom Syndicate, Ltd.
Electrical Instruments Syndicate, Ltd.
Electric Traction Insurance Association, Ltd.
European Electric Railways and Public Works Construction Co.
Tarral Incandescent Electric Light Syndicate, Ltd.
London & North-Western Electric Tramways, Ltd.
Metropolitan Electric Tubes Syndicate, Ltd.
Nottinghamshire Electric Tramways, Ltd.
South-West Wireless Telegraph Ship Co., Ltd.
Tramways Construction Co., Ltd.

Babcock & Wilcox, Ltd.—The directors have declared interim dividends of 1s. 7½d. each on the ordinary and preference shares.

Calcutta Electric Supply Corporation.—The directors have decided to declare an interim dividend on the paid up share capital of the company at the rate of 6 per cent. per annum, for the half year ended June 30th last, payable on November 15th next. This is at the same rate as last year's interim divided.

Direct Spanish Telegraph Co. — The Board has decided to pay in addition to the dividend at the rate of 10 per cent. per annum on the preference shares, an interim dividend, at the rate of 4 per cent., free of income-tax, on the ordinary shares, both for the half-year ended June 30th, 1904.

Hove Electric Lighting Co.—The directors have decided to declare an interim dividend on the paid-up share capital of the company at the rate of 3½ per cent. for the six months ended June 30th last. The dividend is the same as at this period last year; it will be paid on October 15th.

Stock Exchange Notices. — The Committee has appointed Wednesday, the 28th inst., a special settling day in:—

London Electric Supply Corporation, Ltd.—Further issue of 10,000 6 per cent. preference shares of £5 each, fully paid, Nos. 50,001 to 60,000.
United River Plate Telephone Co., Ltd.—Further issue of 12,000 ordinary shares of £5 each, fully and partly paid, Nos. 58,001 to 70,000.

And has ordered the above preference shares of the London Electric Supply Corporation to be quoted in the Official List.

STOCKS AND SHARES.

Wednesday Evening.

WITH the pronounced ease of the Money Market, investment securities are generally firmer on the week, and it is somewhat remarkable that Consols, with their immediate following, should be among the comparatively few stocks to remain irresponsive to the strength of the Bank of England's position. Home Rails have been twisted up with a good deal of strenuousness, although, as soon as the professional onset of buying had ceased, there came a slight reaction. Electric stocks and shares in almost every class are displaying strength; and if it be said that the advances are not very substantial, it must also be admitted that the upward tendency has been quietly proceeding for several weeks past.

In the Home Railway market, Metropolitan Consolidated at 94½ has picked up half its loss of last week, while Districts are quiet at 38½. City and South London continues to forge ahead, and shows another 2 per cent. rise at 47, business having been done at 47⅜. It is only a few weeks ago that City and South London stood at 39½. The company's 4 per cent. Debenture stock is quoted 106½, or a point below the similar stock of the Central London. The Ordinary stock of the latter company has receded 1 to 86, although some sections of the Press are taking its part, and drawing attention to its cheapness. None of the other electrical railway descriptions have altered. Underground "Notes" are 98.

Traction and tramway issues are extremely firm. British Electric Ordinary at 9⅜ have put on 10s., for no particular reason that we could ascertain from well-informed sources. Certainly the market is by no means liberally furnished with shares, but we should venture to imagine that this advance will probably bring sellers along. The Preference shares and the Debenture stocks are unchanged. Anglo-Argentines Ordinary have strengthened ⅛ at 6½, and the Preference also are strong at 5½, thanks to the announcement of the interim dividend on the Ordinary at the rate of 6 per cent. Sympathy with Anglo-Argentines has brought about a further improvement in Buenos Ayres and Belgrano Ordinary, which are now 3⅜, *ex* the dividend of 1s. 6d., making a net rise of 4s. per share. The "A" at 5½ have recovered their dividend of 3s., but the "B" at 5 are about 2s. lower, allowing for their deducted interest. A good deal of business is doing in the Ordinary shares. Metropolitan Electric Preference are a trifle better at 18s. 9d., but the Ordinary at 4s. 6d. fail to make progress. Westinghouse Preference remain at 3 middle.

Telegraph varieties record a number of small improvements. The Anglo-American Co.'s group has recommenced its ascent: the Preferred at 97 is a point up, and ¼ rise has taken the Deferred to 8½. Even Direct United States Cable shares are ¼ firmer at 10½. The Presidential election, in addition to the boomlet in American Railroad shares, is expected to help the cable traffics further, but Submarine Trust certificates stick at about 120. Globe Telegraph Ordinary at 9½ are as much as 10s. to the good, and the better tone has extended to the Preference, which are ¼ harder at 14. In the Eastern division "China" shares are ¼ up at 12½, while the Debenture rose 2 to 106½, and Eastern Ordinary are a similar sum to the good at 130½. A point rise in the company's Debenture brings the price to 107½. Great Northern shares have risen £1, making a £3 advance in less than a fortnight. Western Telegraphs have come into investment demand, with the result that they show ¼ rise at 12½, and West India First Preference also put on 5s. at 6⅜. There are also several other hardenings amongst the prior-charge stocks. The Telephone section has not escaped the firmer feeling that pervades the Telegraph department. National Telephone Deferred maintains its rise to 93½, and the Second Preference shares, which dropped a pound the other day, are back again to 12. Oriental Preference stiffened to 1½, a rise of 1s. 3d. per share. Telegraph Constructions have so far barely participated in the Telegraph firmness, and the price keeps at 35½. Henley's at 11, *ex* the 5s. dividend, are the latter amount better, while the deduction of the 4s. dividend from British Insulated shares is practically reflected in the price, which now stands at 5⅜. Of other Miscellaneous shares, it must be pointed out that Babcock & Wilcox at 3¼ have improved; the Preference are 1⅝. Walter Scott Ordinary at 15s, Willans & Robinson Ordinary at 2½, and the Preference at 3½, do not move. Willans 4 per cent. Debenture was sold on Tuesday at 74⅜, although the official price is 75 to 80.

Three small advances constitute the sum total of changes in the Electricity Supply division. South Londons put on 5s. again at 4½, and are being bought on the assumption that the company is doing very well. A ⅛ rise in Chelseas, represented by the dividend, and ¼ rise in Charing Cross Ordinary to 8¼, may be traced to the regular autumnal strength of the market to which allusion was made last week. And, of course, the quiet awakening of the investor is another important factor, which should make for better prices in electricity supply issues before long.

In the evidence given during the hearing of the Hooley-Lawson case, the price of Blackpool Electric Tramways (South) Ordinary shares was quoted at 4s. middle. Our own Liverpool advices put the price about 3d. cheaper, and the Preference are called 7s. 6d. to 10s., with a very nominal market.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share, ‡	Dividends for the last three years. 1901.	1902.	1903.	Closing Quotations Sept. 14th	Closing Quotations Sept. 21st.	Business done week ended Sept. 21st, 1904. Highest	Lowest
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	97 —101	98 —102	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	2⅛— 3⅛	2⅛— 3⅛	..	..
119,700£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	..	..	..	.. — ..	.. — ..	..	..
788,840	Anglo-American Telegraph	Stock	6½s.	6d/6	6½s.	50 — 53	50 — 53	51½	..
3,105,680	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	95 — 97	96 — 98	98	96½
3,105,680	Do. do. do. Deferred	Stock	2s.	1/-	2s.	8 — 8½	8⅛ — 8⅝	8 7/16	8¼
44,000	Chili Telephone, Nos. 1 to 44,000	5	5 %	6 %	7 %	5 — 5⅛	5 — 5⅛	..	..
13,333,300$	Commercial Cable	$100	8 %	8 %	..	170 —190	170 —190	..	..
1,841,209	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	94 — 96	94 — 96	96	94½
16,000	Cuba Telegraph	10	4 %	6½%	5 %	7 — 8	7 — 8	..	..
8,000	Do. 10 % Pref.	10	..	..	..	15 — 16	15 — 16	..	..
6,000	Direct Spanish Telegraph10 % Cum. Pref.	5	..	..	..	7 — 8	7 — 8	..	..
80,000	Do. do. 4½ % Debs.	50	..	..	..	98 —101%	98 —101 %	..	..
60,710£	Direct United States Cable	20	3½%	3½%	3 %	10 — 10½	10⅛ — 10⅜	10⅜	10⅜
81,800	Direct West India Cable, 4½ % Reg. Deb., within Nos. 1 to 1,200, Red.	100	..	..	..	99 —101	99 —101	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	126 —131	128 —133	132⅔	130½
1,955,565	Do. 3½ % Pref. Stock	100	..	..	..	87 — 90	87 — 90	89⅔	88½
1,534,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	105 —108	106 —109	107⅓	..
800,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	12 — 12½	12¼ — 12⅝	12 5/16	12¼
320,000£	Do. 4 % Deb. Stock	Stock	..	..	..	103 —106	105 —108	105⅝	..
300,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 3,000, red. 1909	100	..	..	..	99 —102	99 —102	..	..
200,000£	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 3,000	25	..	..	..	100 —103 %	100 —103 %	..	..
180,227	Globe Telegraph and Trust	10	5⅛%	£3 16 7*	5⅛%	8⅜— 9½	9⅛— 9⅝	9⅝	9⅛
180,042	Do. do. 6 % Pref.	10	..	..	..	13¾— 14	13⅝— 14⅛	13 15/16	13⅞
150,000	Great Northern Telegraph, of Copenhagen	10	15 %	12½%	15 %	27½— 28½	28⅛— 29⅛	29	..
54,700	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	..	..	..	99 —101	99 —101	..	..
17,000	Indo-European Telegraph	25	10 %	10%	10 %	43 — 46	43 — 46	..	..
72,680	Monte Video Telephone Co., Ltd., Ord.	1	..	..	..	7/16 — 9/16	7/16 — 9/16	..	..
1,988,333	National Telephone, Pref. Stock	100	5 %	6 %	6 %	104 —106	104 —106	105⅛	104⅞
1,966,667	Do. do. Def. Stock	100	..	4½%	5 %	92 — 95	92 — 94	93⅛	92½
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	11 — 13	11 — 13	11⅞	11½
2,250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5 %	5⅛— 5⅜	5⅛— 5⅜	6⅛	..
000,000£	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	97 — 99	97 — 99	..	..
689,593	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	104 —106	104 —106	104½	..
1,000,000	Do. do. Prov. Certs., 35 % to be paid	..	..	..	..	66 — 68	67 — 69	..	..
179,313	Oriental Telephone and Elec. Nos. 1 to 171,604, fully paid	1	6 %	6 %	6⅔%	⅞— 1 1/16	⅞— 1 1/16	1 1/16	..
50,000	Do. do. do. 6 % Cum. Pref.	1	..	..	..	1 — 1⅛	1 1/16 — 1 1/8	..	..
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	97 —100	97 —100	..	..
11,889	Reuter's	8	5 %	5 %	..	6½— 7½	6½— 7½	..	..
3,308	Submarine Cables Trust	Certs.	..	..	..	118 —123	118 —123	..	..
58,000	United River Plate Telephone	5	7 %	7 %	..	6 — 6½	6 — 6½	..	..
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	4⅜— 5⅛	4⅜— 5⅛	..	..
179,947£	Do. do. 5 % Debs.	Stock	..	..	..	103 —106	103 —106	..	..
15,609	West African Telegraph, Shares	10	..	2 %	4 %	6 — 7	6 — 7	..	..
30,008	West Coast of America, 1 to 30,000 and 53,001 to 53,008	2½	..	..	..	1/16 — 3/16	1/16 — 3/16	..	..
150,000£	West Coast of America, 4% Debs., 1 to 1,500 guar. by Brax. Sub. Tel.	100	..	..	..	97 —100	97 —100	..	..
267,980	Western Telegraph, Ltd., Nos. 1 to 267,980	10	7 %	7 %	7 %	12 — 12½	12⅛— 12⅜	12⅜	12 5/16
75,000£	Do. do. 5 % Debs. 2nd series, 1906	100	..	..	..	101 —104	101 —104	..	..
400,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	100 —103	101 —104	..	..
88,231	West India and Panama Telegraph	10	..	..	..	⅜— ½	⅜— ½	..	..
34,568	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	6½— 6⅞	6⅞— 7	..	..
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	5 — 6	5 — 6	5 5/16	5
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	..	..	..	100 —103	100 —103	102¾	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

20,000	British Aluminium 7 % Cum. Pref.	10	..	..	..	5 — 6	5 — 6	..	..
10,000	Do. do. "A" 6 % Cum. Pref.	10	..	..	..	8½— 9½	8½— 9½	..	..
800,000£	Do. do. 5% 1st Mort. Deb. Stock Red.	Stock	..	..	..	92 — 97	92 — 97	93½	..
100,000	British Electric Traction	10	9 %	8 %	..	9 — 9½	9¼ — 10	9¾	9½
100,000	Do. do 6 % Cum. Pref.	10	..	..	..	10½— 11	10½— 11	11	10½
600,000£	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	117 —120	117 —119	119	118
	Do. do. 4½% 2nd Deb. Stock Red.	100	..	..	..	94 — 97	94 — 97	96	95½
100,000	British Insulated and Helsby Cables	5	10 %	10 %	8 %	5½— 6½	5⅝— 6 xd	..	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	5⅞— 6	5⅞— 6	..	..
50,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	..	..	..	101 —104	101 —104	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	..	..	⅞— 1⅛	⅞— 1⅛	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	6 %	..	..	14/6 to 15/6	14/6 to 15/6	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	Nil	Nil	Nil	½— ¾	½— ¾	..	..
150,000	Do. do. Non-cum. 6 % Pref.	2	3 %	6 %	6 %	1 — 1⅛	1 — 1⅛	..	..
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	94 — 97	94 — 97	..	..
25,000£	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	70 — 75	70 — 75	..	..
35,000	Callender's Cable Construction shares	5	20 %	15 %	12½%	9½— 10⅛	9½— 10⅛	..	..
40,000	Do. do. do. 5 % Cum. Pref.	5	..	..	..	5 — 5⅛	5 — 5⅛	5⅛	..
90,000£	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	101 —105	101 —105	103¾	..
1,860,014	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	86 — 88	85 — 87	..	..
494,998	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	100 —102	100 —102	..	..
494,998	Do. do. Def. do.	Stock	4 %	4 %	4 %	79 — 81	79 — 81	..	..
1,880,000	City and South London Railway	Stock	2 %	3½%	2⅔%	44 — 46	46 — 48	47½	45
85,000	Crompton & Co., Nos. 1 to 85,000	5	7½%	5 %	..	1½— 2	1½— 2	..	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	90 — 95	90 — 95	..	..
99,261	Edison & Swan United Elec. Light, "A" shares, £3 paid, 1 to 99,261	5	Nil	Nil	..	½— ¾	½— ¾	..	..
17,189	Do. do. "A" shares, 01—017,189	5	Nil	Nil	..	1 — 2	1 — 2	..	..
44,028£	Do. do. 4 % Deb. Stock Red.	100	..	..	..	77 — 82	77 — 82	..	..
100,000£	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	..	..	..	79 — 83	79 — 83	..	..
a12,100	Electric Construction 1 to 112,100	2	6 %	6 %	4 %	1 — 1½	1 — 1½	..	..
81,890	Do. do. 7 % Cum. Pref., 1 to 81,890	2	..	..	..	2 — 2½	2 — 2½	..	..
82,500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	96 — 99	96 — 99	..	..
35,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	..	9 — 9½	9 — 9½	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	98 — 98	98 — 98	..	..
200,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	20 %	15 %	10½— 11½	10½— 11½xd	..	..
200,000	Do. do. 4½ % Pref.	5	..	..	..	5 — 5⅜	5 — 5⅜	..	..
45,900	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	107 —111	107 —111	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	..	18½— 19½	18½— 19½	..	..
300,000£	Do. do. do. 4 % 1st Mort. Deb.	100	..	..	..	100 —103	100 —103	..	..
87,500	†Liverpool Overhead Railway, Ord.	10	1½%	1½%	..	3⅜— 3⅝	3⅜— 3⅝	..	..
10,000	† Do. do. Pref. £10 paid	10	..	..	..	10 — 10½	10 — 10½	..	..
87,350	Telegraph Construction and Maintenance	12	20 %	20 %	20 %	34 — 37	34 — 37	36	35½
150,000£	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	101 —104	101 —104	..	..
540,000£	Waterloo & City Railway, Ord. Stock	100	3 %	3½%	3½%	86 — 89	86 — 89	..	..

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List.

Bank rate of discount 3 per cent. (April 21st 1904).

SHARE LIST OF ELECTRICAL COMPANIES (continued).—ELECTRICITY SUPPLY COMPANIES.

Present issue.	NAME.	Stock or Share.	Dividends for the last three years 1901.	1902.	1903.	Closing Quotations Sept. 14th.	Closing Quotations Sept. 21st.	Business done week ended Sept. 21st, 1904. Highest.	Lowest
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 ..	£ 5	8%	8 %	10 %	10⅜ — 11⅛	10⅜ — 11⅛	..	..
20,000	Do. do. 7 % Cum. Pref. ..	5	..	..	..	10¼ — 10⅜	10¼ — 10⅜	..	..
250,000	Central Electric Supply 4 % Guar. Deb. Stock	100	..	..	..	107 —110	107 —110	..	..
50,000	Charing Cross and Strand Electricity Supply	5	10 %	10 %	8 %	7⅞ — 8⅛	8 — 8⅛	8⅛	8⅛
70,000	Do. do. do. 4½% Cum. Pref. ..	5	..	..	..	5⅛ — 5⅜	5⅛ — 5⅜	5⅜	5 5/16
40,000	Do. do. "City Undertaking" 4½% Cum. Pref. ..	5	..	..	..	4½ — 5	4½ — 5	..	..
40,000	Do. do. 1903	5	..	..	..	4½ — 5	4½ — 5	4 15/16	4¾
250,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	102 —104	102 —104	10 ½	102½
44,436	*Chelsea Electricity Supply, Ord.	5	4 %	4½%	5¼%	6¾ — 7	6¾ — 7 xd	6 7/16	..
150,000	Do. do. % Deb. Stock Red.	Stock	..	..	..	106 —109	106 —109	..	..
70,595	City of London Electric Lighting, Ord. 40,001—110,595 ..	10	5 %	5 %	5 %	10¼ — 10⅜	10¼ — 10⅜	10⅜	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	..	..	..	13 — 14	13 — 14	13 9/16	..
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid ..	..	..	..	..	120 —125	120 —125	122½	..
800,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	..	..	..	102 —105	102 —105	..	..
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4 %	4 %	8 — 9	8 — 9	8 7/16	..
20,000	Do. do. do. 6 % Pref., 40,001—60,000. .	10	..	..	..	11½ — 12	11½ — 12	..	..
400,000	Do. do. 4½% Deb. Stock	..	..	..	..	105 —108	105 —108	107	106½
250,000	Do. do. 4½% 2nd Deb. Stock	Stock	..	..	..	101 —104	101 —104	..	..
50,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	7 %	6 — 6½	6 — 6½	..	..
80,000	Do. do. 6 % Cum. Pref.	..	..	..	..	6 — 6½	6 — 6½	6 3/16	6 1/16
140,000	Do. do. 4½% 1st Mort. Deb. Stock ..	100	..	..	..	105 —108	105 —108	106½	..
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	10 %	12%	12 — 13	12 — 13	..	..
90,000	Do. do. 4 % Debenture Stock ..	Stock	..	..	..	102 —105	102 —105	..	..
110,000	London Electric Supply Corporation, Limited, Ord.	3	..	..	..	1⅞ — 2⅛	1⅞ — 2⅛	..	..
49,840	Do. do. do. 6 % Pref.	5	..	..	..	5 — 5⅛	5 — 5⅛	..	..
250,000	Do. do. do. 4 % 1st Mort. Deb. Stock Red	Stock	..	..	..	96 — 99	96 — 99	98½	..
100,000	Metropolitan Electric Supply, 1 to 100,000	10	6¼%	7¼%	8¼%	16 — 16½	16 — 16½	16⅝	16⅝
71,106	Do. do. 4½% Cum. Pref. 1—71,106, £3 paid ..	5	..	..	..	5⅜ — 5⅝	5⅜ — 5⅝	5 7/32	5½
220,000	Do. do. 4½% 1st Mort. Deb. Stock	..	..	..	..	110 —115	110 —115	..	..
250,000	Do. do. 3½% Mort. Deb. Stock Red	Stock	..	..	..	96 — 99	96 — 99	..	..
10,852	Notting Hill Electric Lighting	10	6 %	6 %	6 %	14½ — 15½	14½ — 15½	..	..
59,000	Do. do. 4% 1st Mort. Deb.	100	..	..	..	100— 103	100— 103	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	14½ — 15½	14½ — 15½	14½	14½
20,000	Do. do. do. 7 % Pref. 20,081 to 40,080	5	..	..	..	8 — 9	8 — 9	..	..
150,000	Do. do. do. 3½% Deb. Stock Red ..	100	..	..	..	97 —100	97 —100	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	..	2½%	4 %	2⅜ — 3⅛	2⅜ — 3⅛	..	..
50,000	Do. do. do. 4 % Deb. Stock	Stock	..	..	..	83 — 88	83 — 88	..	..
65,000	South London Electricity Supply, Ord.	5	..	1½%	3 %	4 — 4¼	4⅛ — 4¼	4 3/16	4 1/16
100,000	South Metropolitan Electric Light and Power, Ord.	1	..	..	..	⅞ — 1	⅞ — 1	⅞	..
50,000	Do. 7 % Pref.	1	..	..	..	1⅛ — 1⅜	1⅛ — 1⅜	..	..
100,000	Do. 4½% 1st Deb. Stock	100	..	..	..	105 —109	105 —109	..	..
30,000	Urban Electric Supply, Ord.	5	..	..	..	4½ — 5⅛	4⅝ — 5⅛	4 13/16	..
20,000	Do. do. 5 % Cum. Pref.	5	..	..	..	4½ — 5⅛	4⅝ — 5⅛	4 13/16	4 13/16
110,000	Westminster Electric Supply, Ord.	5	10½%	12 %	13½%	12 — 13	12 — 13	12 5/16	12 1/16
28,141	Do. do. 5 % Cum. Pref.	5	..	..	..	6 — 6½	6 — 6½	6 7/16	..

* Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS, Wednesday, September 21st.

CHEMICALS, &c.

		Latest Price.	Week's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a ,, Nitric	per cwt.	22/-	..
a ,, Oxalic	per cwt.	32/-	..
a ,, Sulphuric	per cwt.	5/6	..
a Ammoniac, Sal	per cwt.	42/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33 10	..
a ,, ,, ...	per ton	£30	..
a Bleaching powder	per ton	£4 10	..
a Bisulphide of Carbon	per ton	£15	..
a Borax	per ton	£18	..
a Benzole (90 %)	per gal.	7/-	..
a ,, (50/90 %)	per gal.	5/6	..
a Copper Sulphate	per ton	£19	..
a Lead, Nitrate	per ton	£30	..
a ,, White Sugar	per ton	£31	..
a ,, Peroxide	per ton	£27 10	..
a Methylated Spirit	per gal.	2/6	..
a Naphtha, Solvent (90% a 160° C).	per gal.	5/6	..
a Potash, Bichromate, in casks ..	per lb.	3d.	..
a ,, Caustic (75/80%)	per ton	£24	..
a Shellac	per cwt.	210/-	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6 10	..
a ,, Recovered	per ton	£5 10	..
a ,, Lump	per ton	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	..
a ,, Crystals	per ton	£8	..
a ,, Bichromate, casks	per lb.	2½d.	..

METALS, &c.

b Aluminium Ingots, in ton lots ..	per ton	£180	..
b ,, Wire, in ton lots ..	per ton	£168	..
b ,, Sheet, in ton lots ..	per ton	£166	..
b Babbitt's metal ingots	per ton	£43 to £130	..
c Brass (rolled metal 2" to 12") basis	per lb.	6¾d.	..
c ,, Tube (brazed)	per lb.	8¼d.	..
c ,, ,, (solid drawn) ..	per lb.	7¾d.	..
c ,, Wire, basis	per lb.	6¾d.	..
c Copper Tubes (brazed)	per lb.	9d.	½d. dec.
c ,, ,, (solid drawn) ..	per lb.	9¼d.	..
c Copper Bars (best selected ..	per ton	£71	£1 inc.

METALS, &c. (continued).

		Latest Price.	Week's Inc. or Dec.
g Copper Sheet	per ton	£71	£1 inc.
g ,, Rod	per ton	£71	£1 inc.
e ,, (Electrolytic) Bars ..	per ton	£69	..
e ,, ,, Sheets ..	per ton	£78	..
e ,, ,, Rod ..	per ton	£72	..
e ,, ,, H.C. Wire	per lb.	7¾d.	..
f Ebonite Rod	per lb.	3/8	..
f ,, Sheet	per lb.	3/-	..
n German Silver Wire	per lb.	1/6	..
h Gutta-percha fine	per lb.	8/-	..
h India-rubber, Para fine	per lb.	4/8 to 4/9	..
i Iron, Charcoal Sheets	per ton	£18	..
i ,, Pig (Cleveland warrants)	per ton	43/1½	1½d. inc.
i ,, Forgings, according to size	per ton	From £11	..
i ,, Scrap, heavy	per ton	47/6 to 50/-	..
i ,, Wire, galvanised No. 8 ..	per ton	£9 15	..
g Lead, English Ingot	per ton	£12 2 6 to £12 5	..
g ,, ,, Sheet	per ton	£11 17s. 6d.	..
m Manganin Wire No. 28	per lb.	8/-	..
g Mercury	per bot.	£7 15	..
d Mica (in original cases) small ..	per lb.	6d. to 1/	..
d ,, ,, ,, medium	per lb.	2/6 to 4/-	..
d ,, ,, ,, large ..	per lb.	4/6 to 8/6	..
p Phosphor Bronze, plain castings	per lb.	1/- to 1/2½	..
p ,, rolled bars & rods	per lb.	1/- to 1/8	..
p ,, ,, strip & sheet	per lb.	From 1/1	..
o Platinum	per oz.	£4	..
e Silicium Bronze Wire	per lb.	9d. to 11d.	..
i Steel, Magnet, acc'd'g to desc'p'n	per ton	£68	..
i ,, ,, in bars		£15 to £40	..
g Tin, Block	per ton	£128 10 to £129 10	£1 inc.
g ,, Foil	per lb.	1/6	..
n ,, Wire, Nos. 1 to 16	per lb.	1/7	½d. inc.
p White Anti-friction Metals—			
"White Ant" brand ..	per ton	£42 to £62	..
j Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	8d.	..
j ,, 6 lea. Flax	per lb.	5¾d.	..
j ,, 8 ply 10 lbs. Russian ..	per lb.	4¼d.	..
j ,, 10 lbs. Russian, single ..	per lb.	4¼d.	..
j ,, 180 lbs. Jute rove ..	per ton	£11	..
k Zinc, Sh't (Vieille Montagne brd.)	per ton	£25 15	10/- inc.

Quotations supplied by Messrs.:—a G. Boor & Co.; b The British Aluminium Co., Ltd.; c Thos. Bolton & Sons., Ltd.; d F. Wiggins & Sons.; e Frederick Smith & Co., f India-Rubber, G.P. and Teleg. Works Co., Ltd.; g James & Shakspeare; h Edward Till & Co.; i Bolling & Lowe; j Walter H. Hindley and Co., Ltd.; k Morris Ashby, Ltd.; m W. T. Glover & Co., Ltd.; n P. Ormiston & Sons; o Johnson, Matthey & Co., Ltd.; p The Phosphor Bronze Co., Ltd.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

	Locality.	Week ending	Receipts for the week. £	£*	No. wks.	Total to date. £	£*	Miles open.	*
Elec. Trac. Co.	Aberdeen	Sep. 17	1,496	+231	16	26,067	+ 4,891	10	—
	Bath	,, 14	762	—	38	23,838	—	12½	—
	Birmingham ..	,, 17	5,328	+234	38	203,824	+11,708	3½	—
	Blackburn	,, 16	1,034	+ 94	23	24,556	+ 2,389	12½	—
	Blackpool	,, 15	2,037	+ 455	24	34,941	+ 4,859	8½	—
	,, —Fleetw'd	,, 17	1,170	+ 88	11	16,405	+ 96	7½	—
	,, —Lytham	,, 15	761	+ 34	46	18,249	+ 7,031	7½	—
	Bolton	,, 18	1,956	+102	25	47,520	+ 464	25	—
	Bournemouth ..	,, 14	1,294	+126	24	29,322	—	10½	—
	Bradford	,, 10	4,904	+883	28	111,344	+19,854	50	—
	Brighton	,, 18	1,166	+181	—	27,507	—	9	—
	Bristol	,, 16	5,225	+331	—	—	—	28	—
	Devonport ..	,, 9	601	+ 80	36	19,542	+ 3,257	5	—
	Dudley—Sto'rb'ge	,, 9	988	+ 54	36	31,760	+ 1,284	18½	—
	Gateshead ..	,, 9	940	+ 14	36	32,757	+ 1,429	10½	+ ½
	Gr'n'k—Pt. Glsgw	,, 9	668	+108	36	20,938	+ 1,114	7½	—
	Oldham—Ashton	,, 9	549	— 41	36	19,973	— 886	8	—
	Potteries	,, 9	1,728	+ 22	36	61,370	+ 5,063	28½	—
	South Staffs. ..	,, 9	761	—329	36	27,880	— 4,564	21½	—½
	Swansea	,, 9	557	+ 17	36	20,027	+ 1,008	5½	—
	Wolverhampton ..	,, 9	408	+ 13	36	14,228	— 43	10	+8
	Yorks. Wool Dist.	,, 9	580	+ 94	36	21,749	+ 8,471	6	—
	Miscellaneous ..	,, 9	3,887	—	36	120,549	—	—	—
	Burnley	,, 17	1,063	+212	—	—	—	10½	+2½
	Burton-on-Trent ..	,, 18	369	— 42	24½	9,095	—	8½	—
	Cardiff	Aug. 20	2,189	+101	20	43,465	+ 1,376	14	—
	Chatham & District	Sep. 15	628	+ 32	37	23,079	+ 2,184	8·85	—
	Cork	,, 16	529	— 59	37	17,491	— 2,826	9·89	—
	Dover	,, 17	951	— 8	37	8,385	— 253	4	—

* Compared with the corresponding period of 1903.

	Locality.	Week ending	Receipts for the week. £	£*	No. wks.	Total to date. £	£*	Miles open.	*
	Dublin	Sep. 16	5,042	+231	—	62,162	— 3,115	47	+ ½
	East Ham	,, 17	729	+ 21	24	18,192	+ 1,430	6½	—
	Glasgow	,, 10	14,871	+741	16	210,640	+13,250	71½	+ 5½
	Halifax (2 weeks) ..	,, 7	3,357	+573	23	37,012	+ 3,084	33	+ 1½
	Huddersfield ..	,, 17	1,887	+126	24	33,927	+ 2,760	28	—
	Hull	,, 17	2,182	+373	24	53,109	+ 7,311	13	+ 2½
	Ilkeston	,, 14	142	— 20	24	3,639	—	3·5	—
	Ipswich	,, 17	552	—	24	13,310	—	10½	—
	Isle of Thanet ..	,, 17	1,216	+166	37	29,347	+ 1,548	10½	—
	Leeds	,, 10	6,242	+583	—	149,879	+ 9,400	81½	+ 2
	Liverpool	,, 10	10,655	+ 89	37	383,478	+12,396	108	—
	London C. C. ..	,, 10	13,778	+3508	23	297,959	+61,584	462½	+ 6½
	Manchester	,, 17	12,619	+888	24	304,292	+19,812	137½	+ 12½
	Newcastle	,, 17	3,619	+217	—	—	—	17	—
	Portsmouth	Aug. 27	2,673	+200	—	47,053	+ 4,188	14½	—
	Salford	Sep. 12	4,045	+209	28	98,276	+ 7,088	30	—
	Sheffield	,, 11	4,690	+278	24	114,694	+ 2,952	33	+ 6½
	Southampton	,, 8	1,317	+112	—	—	—	9	—
	Southend-on-Sea ..	,, 14	476	+ 67	24	10,486	+ 1,167	6½	—
	Sunderland	,, 18	1,274	+560	25	32,948	+ 356	21	+ 1
	Tyneside	,, 14	450	+123	37	14,470	+ 2,307	8·9	+ ·4
	West Ham	,, 16	1,122	—	29	26,126	—	8·62	—
	Wolverhampton ..	,, 14	740	+310	—	—	—	9·5	—
	Cen. London Rly. ..	,, 17	6,028	+188	11	64,150	— 1,427	6	—
	City & S. Lon. Rly.	,, 18	2,493	· 11	12	28,253	— 1,134	6½	—
	Dublin—Lucan Rly.	,, 16	180	+ 1	11	1,615	— 14	3½	—
	G. N. and City Ry.	,, 17	1,080	—	31	29,517	—	3½	—
	L'pool Overh'd Rly.	,, 17	1,561	—129	12	20,045	— 551	6½	+4½
	Vesuvian Railway	,, 17	520	+208	11	15 858	+ 1,172	14	—

ELECTRIC TRACTION SYSTEMS.

We appear to be in for a royal time. Wigs enough were on on the green when no more than two systems of lighting—the three-wire continuous and the single-phase alternating—were the sources of controversy. What encounters may we not expect now that so many systems, and variations of systems, have entered the lists to fight to the death, or as near it as they dare, for the fair lady Traction?

How many champions are there? (1) 500 to 650 volts D.C. generated, transmitted and used in motors; (2) H.T. or E.H.T. polyphase generation, and in either case E.H.T. transmission, entailing sometimes stepping-up at the entrance to the lines, followed by stepping-down prior to conversion to D.C. at 500 to 650 volts for distribution to cars and motors; (3) D.C. generated and transmitted direct to motors at 1,000 to 2,000 volts; (4) polyphase generation and transmission at H.T. or E.H.T. to transformer sub-stations from which lower voltage polyphase currents are distributed to motors; (5) H.T. or E.H.T. polyphase transmitted direct from generators to motors; (6) single-phase H.T. or E.H.T. generation and transmission to transforming sub-stations or direct to transformers on cars, from which L.T.-S.P. current is supplied to one of several kinds of motor of the series-commutating type; (6*a*) the application of D.C. or A.C.-S.P. currents to this motor as occasion serves. Until further information is available about Mr. B. J. Arnold's A.C. compressed air system, it is not needful to add that to the bewildering list.

Perhaps our embarrassment will begin to disappear if we consider that the word "traction" is highly comprehensive. What does it include?

(*a*) Main line long-distance work.
(*b*) Tube and elevated lines.
(*c*) Branches of main lines and light interurbans.
(*d*) Tramways and restricted light railways.

At least (1) and (3) may be eliminated with respect to (*a*) and (*b*), so that these have four electrical systems and steam to play with; but (*c*) and (*d*) must see all the electrical systems doing battle for their favours, with steam still going strong for branches of main lines.

May we not strike out (2) for all kinds of work? That sounds like very drastic treatment for a system which has been developed so immensely in America, and is used to some extent in England, with more on the way. But what else can we do when we know by how little (2) beat (5) in the great fight over the underground conversion, and add to our knowledge the presence of (6) which overpowers (5), by reason of its single overhead conductor and its greater speed flexibility?

Why was the "three-phase-throughout" system beaten? Because of its inflexible nature with regard to speed, and because of the comparatively complicated contact lines. Is it not probable, therefore, that the single-phase system, which possesses all the advantages of the three-phase without the two objectionable features above, would have won the hand of the Underground Railways, if it had been grown up a little sooner?

For express traffic on main lines, whether passenger or goods, the polyphase motor will be satisfactory enough, but there is too much work done on railways at various speeds to make any constant speed motor more desirable than a variable speed motor.

No other than a high pressure system right up to the cars, and perhaps up to the motors, for main line work is conceivable in the state of our present knowledge, and the fight over this section of traction will be confined to the A.C. class; and looking ahead as we must, it does seem to us clear that the light weights will follow the heavy on account of the relations between them, which must become more and more intimate. Short branches might be operated by D.C. more advantageously than by A.C., but the main line being A.C., the offshoot will be nothing else—unless, of course, it is found to be still more beneficial to stick to steam in some form.

Far as we may look into the future, we do not see the day of nationalisation of all railways, and we observe that until that not too happy era arrives the several British railways will not be worked on one principle only. For that reason the future railway motor will be a most adaptable contrivance, which the recent improvements so sounded through the world by the premier American electrical companies are foreshadowing.

By means of the simplest adjustments, such as the removal of a trolley-pole, or the closing of a switch, the multiple-cars or the locomotive will pass without interruption from an A.C. to a D.C. feed, or from a three-phase to a S.P. system. This kind of thing will not be economical as compared with one universal system, but man's approach to uniformity happily has never been more than approximate, and we may as well resign ourselves beforehand to the inevitable unlikeness of methods for attaining similar ends; differences which look like confusion to contemporaries, but make for improvement and higher orders of simplicity in veiled mysterious ways.

At the present time the A.C.-S.P. motor is being made much of, as one which works admirably on D.C. circuits. That is only natural considering the vast preponderance of D.C. circuits, and the boom will serve a good end, although just now the men behind the boom do not feel quite sure what A.C. advantages it will be wise to drop in order to corral the D.C. tramways. They see that it is through the heavier interurban tramways that they must attack the coveted main lines. In Schenectady—curiously near certain large works—the General Electric Co. equipped the Ballston extension 16 miles in length; in Illinois another interurban, 30 miles long, to handle passengers and heavy freight, is about to break ground—both on the S.P. system. Success being attained on these and others like unto them, railway managers will be touched at last, and the less important branch lines will be tackled, or a particularly progressive company may give up a main line section for trial. Most of them are primed already with figures relating to economy or losses attendant on converting to electricity by means of the A.C. converter system, which they could see was not so impossible as some of the earlier schemes which they had been asked to swallow, and the greater simplicity and other comparative merits of the S.P. system will appeal to them in a not unreasonable time when there are a good many baby railways in successful operation which present something more tangible in the way of demonstration than reams of estimates and infallible calculations.

It is vital, therefore, to make the S.P. motor work on D.C., as the majority of interurbans are bound up more or less intimately with urban tramways proper. This will lead to all kinds of compromises and makeshifts in the first instance, and will have an end in the development of a highly satisfactory equipment for town and country work on A.C. or D.C. as desired.

Considering the growing number of polyphase generating stations, and the professional inertia which is no more absent from electrical engineers than from other classes of society, and considering the extensive experiments in three-phase traction which have been made and are progressing, it may be that some main lines will be equipped with three-phase contact wires, so that constant-speed expresses may utilise the constant-speed motor, while stopping trains of any class will use one phase only. Balancing difficulties will be overcome. But unhampered lines will start right away with the simplest system. Interurban lines already constructed on the polyphase D.C. system will not be able to consider scrapping their polyphase generators, transformers, and switchgear in addition to their rotary converters and D.C. motors and switchgear, so that phase transformation will be used when D.C. currents become too heavy for safe collection, and distribution losses too great.

Coming to tramways, as we know them in England, we do not see how the advent of the A.C.-D.C. motor can cause any revolution in general practice. On very large city systems where two or more power stations and many sub-stations are in use, it may be found more economical to supply to more frequent stationary transformer sub-stations which will feed the trolley wires at the highest voltage permitted. Outside these few cities, our tramways are not too large to be worked with the maximum possible efficiency by D.C., and later on, when trolley voltages of 1,000 and upwards are permitted, this efficiency will be raised far beyond the reach of any A.C. system. There will be no immediate excuse, therefore, for councillors to journey to the ends of the earth, note-book and liver-pill in hand, to investiga

the new system with a view to its adoption within their own town.

At some future time, when the public has become sufficiently educated to recognise that the number of power stations per square foot is altogether too enormous for calculation, and that a tenth of a tithe of the density would serve our ends and our pockets much better, it may be that the S.P. motor will threaten the present supremacy of its progenitor in tramway work, for, by that time, interconnection and running powers will be accepted as logical. But by that time also the *Daily Mail* will have brought into the world a Pocket Power, which will make every man his own automobile, and A.C. and D.C. motors will become as extinct as the steam locomotive.

THE POWER PLANT OF TALL OFFICE BUILDINGS.

(*Concluded from page* 477.)

Next in importance to the elevator service comes the heating question. This is a matter which concerns the electrical engineer indirectly only. But it does concern him, more particularly the consulting engineer, who may have the supervision of the whole of the power equipment. If the exhaust from his engines is to be blown through a few hundred (perhaps thousand) yards of piping, the back pressure he is likely to get is a matter he wants to know something about.

We are, of course, premising an electric generating plant on the premises, which is quite the usual thing in these large American buildings. The electric lighting plant is really only a small part of the whole power plant required when we consider the pumps for hydraulic elevators, the heating, refrigerating, ventilating, vacuum cleaning, and water supply service pumps, &c. In summer time, the elevators, ventilating, and refrigerating machinery are at work all the day, and in winter the elevators, ventilating, and heating apparatus are required throughout the day, and the electric light at night only. It is because boilers, engines, and engineers are necessary for other purposes that the cost of generating electric lighting is so small, that it would not pay to take a public supply.

On the question of the heating of buildings there is a considerable diversity of opinion. Whilst some experts believe in steam-pipes and radiators throughout, others advocate warm air circulation by means of fans (electrically driven of course), and others again consider a combination of radiators and air circulation to be the correct thing. The Englishman likes his fire, but in the modern office blocks this is practically out of the question, and he must be content with the steam heated radiator. Why not the electric radiator? Because the steam is there, and it is better to make use of it in warming the building than in blowing it off into the air or in warming up condensing water. What it amounts to is that we have an air cooled condenser distributed throughout the building in the form of radiators.

But having dispensed with the fire, we have spoiled the ventilation, and herein lies the necessity for a system of forced air circulation. The methods of controlling the temperature and designing the piping systems are gone into in the papers under discussion, and for further details we refer our readers to the original papers. English visitors to the States generally complain of the overheated hotels and offices; the Americans complain of it too, and no wonder; they do not appear to understand the matter, and seem to be working on wrong lines altogether. Mr. Wells in his papers emphasises and enlarges on the basic idea the Americans work on, viz, a constant temperature of 70° F. in the buildings regardless of the temperature outside: and he is at great pains to show that each room in a building should be thermostatically controlled to effect this object. But this is all wrong in principle. When the thermometer stands at zero in the open, we do not want to suddenly enter an atmosphere at 70° F., nor do we relish as suddenly changing from 70° to zero. It is not quite so objectionable in summer time to change from 100° F. in the shade to an office cooled down to 70° F., but it will be found that this temperature is apt to feel even chilly under the changed circumstances. What is really needed is a maximum and minimum difference between the temperature inside and that outside, the inside winter temperature being considerably lower than the summer.

But enough of this. A point of more immediate interest to the engineer is the method of reducing the back pressure on his engine when exhausting into the heating system. This is now effected by the use of small vacuum pumps or air suction pumps by means of which the back pressure on the engine can be reduced to, say, ½ lb. or less.

Another advantage of the vacuum system is the very large reduction in the sizes of pipes required. The system is used to some extent in London, and there are many places where its adoption would result in the shutting down of the low-pressure heating boilers, improved economy in the engines, and considerable saving in fuel. This again enlarges the sphere of the electric motor, which would be needed to drive the vacuum pumps.

Electric motors are used also in these large office blocks for deep well pumping, and for subsequently raising the water to tanks at the top of the building. Some London buildings have wells some 300 ft. and more in depth. It is apparent, therefore, that electricity plays a very important part in the lighting and power equipment of the modern office block, and finds a field of growing importance in the large blocks of residential mansion flats of the better class.

As regards the wiring and the electric generating plant—when electricity is generated on the premises—English practice differs in some particulars from American. Touching on this section of the work, Mr. Wells, in his paper, says:—"The engineer who is at the head of this department has his work cut out for him. It is the most complex and difficult portion of the design, and requires a large amount of technical education and experience. Practice changes continually, and the science has advanced so rapidly that an up-to-date electrical engineer has to give more time to his profession than does the engineer in any other department."

He then gives details of the electrical equipment in a typical building, based on an average of about 50 of the tall buildings in New York City. The total floor area to be lighted is taken as 196,700 sq. ft., requiring 5,316 lights on a basis of one light for each 37 sq. ft. of floor area, plus 250 lights for decorative effect in the banks and principal offices, making a total of 5,566. At 55 watts per lamp the total output for lighting required would be 306 KW. The only electric power reckoned on is two 15-H.P. fan motors. From this it is clear that all auxiliary machinery, such as pumps, &c, are steam-driven, and the elevators worked by hydraulic power.

The average loads are given as under:—

—	Load in KW.	Generating plant in use.
Absolute peak load... ...	234 KW.	2 sets of 125 KW
Average peak for dark days	203 „	1 set of 125 KW., and 1 set of 100 KW.
Average peak for 8 months	112 „	1 set of 125 KW.
Average day load for 6 months	82 „	1 set of 100 KW.
Average low load for 12 months	69 „	1 set of 100 KW.
Average nights, Sundays and holidays	50 „	1 set of 50 KW.

The generating plant installed would, therefore, consist of two sets of 125 KW., one set of 100 KW., and one set of 50 KW. The object of this extraordinary arrangement is to work the generators at their best economy. For a peak load of 234 KW., we thus have a total plant capacity of 400 KW. The conditions would be met just as satisfactorily, and with probably equal economy by two 100-KW. sets with an overload capacity of 25 per cent. to take the peaks, and this is the arrangement that any practical consulting engineer in this country would adopt, using either the public supply as a standby, or installing a reserve set making a total plant capacity of 300 KW., the plants being identical, reduces spare gear to a minimum. To load an installation of this size with the cost of four generating sets of three different

sizes, together with the somewhat involved switching arrangements, is neither good engineering nor good business.

The total output for lighting is given as 370,250 units per annum, which works out to over 65 units per 16-C.P. lamp.

To this total must be added 60,800 units for motors, making a grand total of 431,050 units per annum—not a bad consumption for a single installation.

Touching on cost of production, the author calculates on a basis of 24 lbs. of steam per H.P. per hour, and an evaporation of 8 lbs. per lb. of coal, or 3 lbs. of coal per H.P. per hour. This seems too good a result to be true of a plant operating on such a variable load, notwithstanding the chopping and changing from one set to another in order to work them at their best economy. Drainage and feed pumping must, of course, be included in the steam consumption, and also the condenser pumps. A good quality coal at 36s. a ton is reckoned on ; water, 5d. per 100 cb. ft. (say, 8d. per 1,000 gallons) ; oil, waste, &c., £83 10s. per annum ; interest and depreciation, £625 ; ash removal at 5 per cent. of the cost of coal ; and labour (half the cost of labour in the boiler and engine rooms), £520, making a total cost of nearly £2,240 per annum, or about 1¼d. per unit. The authors bring the figure out to 2¼ cents, but it is more nearly 2½ cents, which is not a bad result, considering the cost of labour and coal, and compares favourably with the cost of a similar installation in this country. As the load is principally a lighting one, the cost of energy from a public supply—say in London—would have been fully double the cost of generating in the building. It will be noticed that interest, depreciation and labour count for more than half the total costs, that is, they amount to more than ¾d. a unit. A larger motor load in the daytime would have reduced this item, and, if electricity is not so good as hydraulic power for the elevator service, there is no obvious reason why electric pumps should not be used to store the necessary water-power for hydraulic lifts. This would give a very steady load, and, so far as the generating plant is concerned, would be a better load than if electric lifts were used. This suggestion is worth consideration for London work, where, with current at 2½d. a unit, the cost of running electric lifts is about one-quarter that for hydraulics for an equivalent duty.

In the matter of wiring, the principal difference between English and American practice is that the Americans stick to low voltage—120 to 125 at the generators, and run three-wire feeders to the distribution centres. An installation of this magnitude would not be laid on so low a voltage here, and from the main switchboard two wire circuits would be taken so arranged as to permit of a three-wire supply being used as a stand-by.

The two papers contain much practical information—as is usual in papers read before American scientific societies—on other engineering matters connected with the equipment of tall office buildings, and are well worth reading.

THE OPERATION OF SYNCHRONOUS CONVERTERS.

THE *Western Electrician* for August 20th, 1904, contains a paper by Mr. S. C. Lindsay, which states the various troubles met with in the operation of synchronous converters at Seattle, and describes how they have been overcome.

The power was transmitted in the first instance at 15,000 volts over two to three-phase lines, the conductors for each line being No. 2 solid aluminium wire. It was originally planned to use one line for power, and the other line for lighting and such power loads as were subject to large and sudden changes. The current for the synchronous converters was transformed to 340 volts by three 500-KW. transformers connected delta fashion on both sides.

One converter alone would work satisfactorily with the lines in parallel, but, keeping the load constant, and throwing in a second converter, they would immediately begin to hunt to such an extent as to open the circuit-breakers at the power house.

No further attempts were made to operate two machines until the voltage of transmission was changed to 30,000 volts, when it was found that both synchronous converters would operate perfectly satisfactorily up to their full capacity with the transmission lines in parallel ; but if the lines were separated, hunting would commence, unless the load was reduced. In fact, more load could, without disturbance, be carried by one machine than by two. When these attempts were made to operate two synchronous converters from one line, the line was loaded in almost every case with the induction motor and lighting load that was always carried when both lines were in parallel.

The difficulties were, however, overcome by replacing the transmission lines by 0000 aluminium wire, and by using a separate bank of transformers for each converter.

One source of great trouble was breakdowns in the transmission lines, which caused serious flashing at the commutators of the converters. This trouble was, however, obviated by earthing the neutral point of the transformers.

As the chief troubles were due to faults in the commutators, it was found that the greatest attention had to be paid to keeping them free from short-circuits which might arise from a too free use of oil employed in cleaning them ; only sufficient should be used to prevent the copper dust from flying, but not enough to form a paste.

SIMPLE STORIES.

BY "INNOCENS."

IX.—A PREHISTORIC PEEP.

According to the local Press, the following incidents occurred during the discussion of a purchase of boilers at a recent Urban District Council Electric Light Committee meeting. Mr. S., a member of sub-committee, wrote, " . . . . Mr. W. put himself into communication with Messrs. Babcock & Wilcox without his (Mr. S.'s) knowledge . . . . When he spoke to Mr. W. upon the subject, that gentleman said he was mad, and he would like to kick him." Mr. W. replied that, "With regard to his statement that Mr. S. was mad, it was merely an expression of opinion . . . . The manner of Mr. S. was most insulting; in fact, he seemed so full of suspicion that it really led him (Mr. W.) to think that a man who appeared so suspicious was really open to suspicion himself . . . . ," also, " . . . . Mr. P., who was not a member, had sat at the table and voted illegally." Mr. P. cleared himself of this charge by stating that "there was another meeting pending at the time, and he sat at the table not knowing what was going on at the time!" Mr. C. cast some doubt on this statement by asserting that "Mr. P. voted deliberately, well knowing what was being discussed at the time."

The meeting, it is pleasant to record, terminated without serious mishap.

The navvies engaged upon the excavations for the new boilers at the Winkleton electric light station have come across a fragment of rock bearing rude hieroglyphics, which, though somewhat worn by time, and mutilated in the process of excavation, is still a relic of the most intense interest as revealing in a hitherto unattainable degree the communal activities of the people who lived and struggled in those far-off times. Prof. Blödsinn, of Munich, the renowned archeologist, has furnished us with the following free translation of the inscription :—

(The beginning of the writing is undecipherable, owing to the fact that portions of the rock have been broken away.) " . . . . and as they sat in Witenagemot, a messenger came in hot haste from "—here appears a species of totem-sign, resembling a partially clenched fist, which the Professor translates as "Scratch"—saying, "I have saddled my ichthyosaurus, and am coming quickly with my war club. Let—" (a figure of fir trees standing on a horizontal ground line, which the Professor translates as "Wood") "—beware, for I am angry." Then Wood arose, and, girding his bear-skin round his loins, spat upon his hands. Now Scratch and Wood had been sent out to exchange cockle shells for cooking pots on behalf of the tribe, and they had agreed to go to the Richardsonii, who made good cooking pots. But while Scratch was away hunting, Wood had gone to the tribe of the Babcocks, and bought the pots there. Wherefore Scratch was wroth.

"So when he came to the Witenagemot he was haughty to Wood and brandished his club in his face, saying, "And

why dids't thou go behind me and buy of the Babcocks? Am I a fool?"

"And Wood kicked him sorely in the ribs, saying "You are mad! You are very mad!"

"And no more was said. But Scratch led off with a splendidly-delivered smack from his club on Wood's crown, which Wood equalised by landing a rock on Scratch's nose. After several indecisive scrimmages Scratch got in a telling jab in Wood's wind, which advantage he followed up by jumping on Wood once or twice.

"And when time was called the remainder of Wood rose up and explained that what he had said was only a little expression of opinion and of no consequence whatever. He thought the behaviour of Scratch was most insulting, and it hurt him very much. He felt it all over, particularly in the wind. A man who was so suspicious of a friendly kick as to start fighting immediately, was acting in a way that laid that man also open to suspicion. If he (Wood) only felt a little better, he would be pleased to commence the second round at once.

"As it was, he merely wanted to draw the attention of the Witenagemot to the unfair behaviour of . . . ."—a drawing of a cockle-shell appears here. Prof. Blödsinn, after strenuous thought and a consideration of the context, has arrived at the opinion that this is the badge of a man who (or whose ancestors) first introduced the cockle-shell as the standard of currency among the tribes. Instances of such honours being conferred are not rare—an analogous modern instance being the application of the term "Whitworth Scholar" on a youth who could never have seen Whitworth, but had passed a large number of examinations. Returning, then, to our text, Wood wanted to complain to the Witenagemot "of the unfair behaviour of Cockle, who had hindered him in his movements during the recent argument by inserting a spear-shaft between his (Wood's) legs, and tripping him up. Cockle protested, saying that he was indeed sitting on the Druidical altar, playing with a spear, but that he was quite unconscious that any argument was going on at the time, as he was immersed in thought.

"Then the Peace-Maker (so called because he was good at stirring up mud) asked him how he had accounted for the stone that hit him on the ear, if he was so steeped in meditation that he had not noticed the scuffle. Cockle replied that he thought an acorn had dropped. Then said the Peace-Maker to him: 'You ——' (here a pick-mark unfortunately obliterates some of the signs) '—— liar!' So Cockle flung his spear. . . ."

It is unfortunate that here, at the most interesting portion of the debate, the record should end. One conjectures vainly as to what occurred to the unfortunate Peace-Maker. The mists of ages have again closed round the glimpse of the past. Yet even this memorial, incomplete though it be, shows us that throughout the centuries the spirit of humanity has not altered. For how vividly we are reminded of our own Borough Councils!

RECENT ADVANCES IN ELECTRO-CHEMISTRY.*

By BERTRAM BLOUNT, F.I.C.

The greatest of all electrolytic industries is the refining of copper, about 70 per cent. of the world's production being thus treated, and in the United States alone, 250,000 tons per year, yielding 27,000,000 ozs. of silver and 346,000 ozs. of gold are annually treated.

The Anaconda Works, being the largest in America, and using, in all, about 3,000 H.P., has an output of about 100 tons a day; the plant consists of 1,200 tanks, covering 2¾ acres, the electrodes are arranged on the multiple system, and the handling of each tank load (about 4 tons) is effected at a single mechanical operation.

The average current density of a copper refinery is 10 amperes per square foot of cathode surface, if this is much exceeded, nodular deposits begin to show themselves. Thus it comes about that every practicable means is employed to increase the available current density without impairing the quality of the deposited copper. There are several methods of attaining to this end. The electrolyte may be rapidly circulated, so as to keep a supply of copper always in the neighbourhood of the cathode, or it may simply be kept at a temperature of about 100° F., when a current density of 20 to 25 amperes may be employed. A special device for rapidly circulating the electrolyte, and at the same time forcing air into it, has been introduced by Mr. Dolphin, of Liverpool, and the process has the incidental advantage of oxidising the iron salts and causing the precipitation of the antimony. Among other methods which have been introduced for overcoming the same difficulties, are the rotating cathode of Mr. Cowper-Coles, and the well known Elmore process.

The reduction of copper from its ores is another matter, and has occupied much attention. Most of the methods put forward may be summed up in the following way:—Sulphide copper ores are roasted, and leached with sulphuric acid; the solution thus obtained is electrolysed with insoluble anodes, so that it is partially depleted of its copper, and the liquor is then turned back to leach more ore. Perhaps the most promising effort yet made to realise this is due to the Inter-Colonial Copper Co., at Dorchester, Canada. The ore worked is a sulphide, slightly weathered, and contains about 2·4 per cent. of metal. The output is at present about 1 ton per day.

The electrolytic refining of zinc is not yet practised. If there were a large demand for a purer form of zinc than can be obtained by the existing processes, electrolytic methods would probably be employed for its production.

With regard to the winning of zinc from its ores, the extreme inefficiency of the existing process makes it most probable that electrolytic methods will ultimately step in. In spite of the attention that has been given to the deposition of zinc, the practical results have been small. At the present time, the only method known to be in use is a modified form of Hoepfner process which has been developed at Brunner, Mond & Co.'s works. It is based on the fact that zinc chloride can be prepared by acting on calcium chloride with zinc carbonate, or industrially by using, in place of zinc carbonate, roasted zinc ore and carbonic acid.

The zinc chloride is electrolysed, and the zinc from the ore and the chlorine from the calcium chloride are recovered in marketable form.

A somewhat unique process is that of Swinburne and Ashcroft which has been worked out in practical form, sulphide ores are Bessemerised with chlorine, and the zinc chloride thus produced is reduced in a fused condition.

The history of the electrolytic reduction of nickel is curious. A few years ago electrolytic nickel was a merchantable article; at the present time it is doubtful whether any is being made, and this fact is probably due to the greater activity of the manufacturers using the older process. The most serious attempts in this direction have been made by Messrs. Vivian, of Swansea, who used a nickel-copper alloy obtained from Sudbury ores, and by the Balbach works of New Jersey, but the latter process was only intended to refine nickel already containing 94 to 97 per cent. of the pure metal.

Owing to the extreme efficiency of lead reduction, there would appear to be some doubt as to whether it will ever rank as a metal for which electrolytic methods are advantageous.

The Electric Reduction Co., at Niagara Falls, have a process for reducing galena. The crushed mineral is used as a cathode in lead trays in an electrolyte of sulphuric acid. Sulphurated hydrogen is evolved, leaving spongy lead which is burnt to litharge.

The Canadian Smelting Works, of Trail, B.C., have adopted the process of Mr. Betts for refining crude lead in a solution of its fluorsilicate, and thus recovering the gold and silver. The chief merit of this electrolyte is its great solubility and its power of yielding compact deposits of lead. A plain fluorsilicate solution gives tree-like growths, but if gelatine is added the lead comes down in a dense form.

Aluminium carbide is of no commercial value at present, and hence electric furnace methods for its reduction are not directly practicable. Broadly speaking, there is one process

* Abstract from the Cantor Lecture recently delivered before the Society of Arts.

for the reduction of the metal, which consists in electrolysing the oxide in a fused bath of cryolite with a carbon anode and aluminium cathode. The fact that alumina contains only about half its weight of aluminium, and that to produce the pure metal, pure alumina must be used, makes the supply of the latter of vital importance, in fact, this constitutes probably one-third of the total cost of manufacture. Any method of cheapening it, is therefore, at present one of the most important problems. It is a matter of some wonder why aluminium has not been used more extensively for making bronze, seeing that this alloy is capable of such general application. The output of aluminium is, however, annually increasing, amounting in 1901 to 7,571,211 kilos, of which 3,311,213 kilos were reduced in the States.

The Castner process for the reduction of sodium from fused caustic has reduced the price of this metal to less than edible butter, but the demand is very limited, and although the electrolysis of the chloride would, if successful, considerably reduce the price, the need for so doing does not seem to have been sufficient to warrant extremely great efforts in this direction being made. A process for electrolysing fused sodium nitrate and caustic soda, separated by a porous division and using iron electrodes, has been worked out by Darling, and is being exploited at Messrs. Harrison's works at Philadelphia. Sodium and NO_2 are the products, the latter being hydrated to form nitric acid.

Ashcroft has recently invented a method which employs sodium chloride and caustic soda, fused, and he interposes a secondary, or intermediate electrode of fused lead. Sodium and chlorine are the products. Circulation of the alloy at the bottom of the melt is obtained by an electro-magnet placed beneath the cell.

The difficulties arising out of the spongy nature of zinc deposits from solution have given rise to endeavours to electrolyse the fused chloride, and in this direction the apparatus devised by Swinburne for the Phœnix process has attained considerable success. This process is, however, of general application for the treatment of sulphide ores.

Notable among electrolytic products are alkali and bleach from the chlorides. The chief existing processes fall into two classes—(1) those using an intermediate mercury electrode, and being conducted in solution; and (2) those involving the use of fused electrolytes and a cathode of melted lead. The former is exemplified by the Castner-Kellner process, in use at Runcorn, and a typical example of the later is the Acker process, in use at Niagara, which is of the internal-heated type.

Other types in which a diaphragm is used, or in which the solution is separated by its specific gravity, such as the Hargreaves-Bird or the Le Sueur, are also giving practical results.

The manufacture of hypochlorites from solutions of alkali chlorides is an established industry, as is also that of the more flourishing potash chlorate. The latter is a simple matter, and but little protected by patents; consequently it remains in the state of a mass of trade secrets, details of manufacture being hard to obtain.

Among the somewhat secondary applications of electrolysis to manufacture, may be mentioned Cowper-Coles's process for preparing large mirrors and plating them with palladium; the commercial manufacture of oxygen and hydrogen from aqueous solutions of caustic; the manufacture of baryta by heating heavy spar with carbon in the electric furnace; the recovery of gold from weak cyanide solutions in the process of the extraction of this metal from quartziferous tailings, and, lastly, but in a rather different connection, the recovery of atmospheric nitrogen and its conversion into nitrates.

Since electrolysis is simply another method of oxidation and reduction, it is obvious that many organic reactions might be thus brought about that are now done by purely chemical means. In this way iodoform has been produced from potassium iodide in presence of acetone or alcohol, anthracene has been converted into anthraquinone in the presence of a chromium salt, which acts as a carrier of oxygen, and many other practical reactions have been brought about.

Although electric furnace reactions cannot be considered as electrolytic, nevertheless they are truly electro-chemical, several important and new substances are exclusively the product of the electric furnace, and many others can with advantage be produced in this manner, on account of the extremely high temperatures which can be obtained, and the convenience with which the heat can be applied.

In the first category may be included carborundum, a product of silica and carbon, so largely used as an abrasive, the chief supply being from the Acheson Works of Niagara.

At the same works a new product is being developed, namely, so called siloxicon to which the formula Si_2C_2O has been assigned. Although not an abrasive, this substance has applications of its own on account of its extremely inert properties.

Next comes calcium carbide, unquestionably the largest product of the electric furnace. The furnaces fall into two classes; those from which the fused carbide is tapped, and those from which it is removed after the charge has cooled. In a modern carbide plant 1 H.P. year is said to produce as much as $1\frac{1}{2}$ tons.

The conversion of carbon into graphite has, at the hands of Mr. Acheson, met with such success that this industry has now thoroughly established itself. The raw material is usually anthracite for mass graphite, and petroleum coke for the electrodes.

Among the reactions which are receiving general attention, but which have not so far attained to practical success, are the reduction of iron and zinc, the former is obviously merely a question of heat efficiency, and it is doubtful, therefore, whether electric heating can ever replace ordinary combustion, except where water power is available and fuel practically unobtainable.

Phosphorus and carbon bisulphide are two products easily obtained by ordinary methods, but on account of the convenient way in which electric heat can be applied, there is considerable promise of their becoming products of the electric furnace.

The last application of the electric furnace is for pure fusions; thus amorphous alumina can be melted, forming an artificial corundum, which, as an abrasive, rivals carborundum.

Similarly, silica may be converted into a quartz glass, which, on account of its great strength and small dilatation, bids fair to displace glass for many purposes.

THE CARE OF SWITCHBOARDS.

It is surprising to notice, in visits paid to central stations for the supply of electricity, evidences of the fact that, while systematic attention is devoted to the cleaning of the buildings and mechanical plant, and some little effort is made to keep the electrical running machinery in good order, very superficial notice is often taken of the condition of the switchboard. An instance of this came under our notice at a station whose switchboard was of the "flat-back" type. The marble front was beautifully clean, the glass and brass of the instruments were brilliant in their polish; but the engineer was unwise enough to show us the back of the board. A heavy coating of dust lay on the bus-bars and cables, a mop and pail of water stood in one corner adjacent to a resistance frame, and balanced on the angle-irons of the frame-work was an assemblage of pint-pots, cups and parcels of food, this portion of the board being evidently reserved as a pantry by the switchboard attendants. This laxity is all the more astonishing because the board is the point of assemblage of all the power developed by the plant in the station prior to its departure to the feeding-points of the system.

The reason for such neglect is probably that, with a continuous supply, the board is never entirely available for overhauling and cleaning. Parts which are in operation, or regarded as "spare," are exempted from strict examination owing to risk of life or other causes. The danger of this is, however, apparent to anyone who has had the opportunity of seeing what dust can do in increasing leakage, and noticing the effect of loose connections in increasing the drop of volts in a bus-bar.

A switchboard should be subjected to a detailed examination as often as, and of as severe a nature as that of the rest of the plant, which, though perhaps occupying more space,

is, after all, only of the same power-capacity as the board. This should be undertaken by the engineer-in-charge, and he should be particularly on the alert for loose connections. It is not a wise policy to wait until a screw drops out and an open circuit is formed before making an anxious investigation and a penitential report. A half-hour spent with a spanner and screw-driver say, once a week, may save the credit of the station. It must be remembered that in a power-house there is nearly always vibration constantly tending to jar connections loose. Alternate expansion and contraction of metal parts by heating as current is passed through them or interrupted aids vibration in making these parts work loose.

Dust in an engine room is usually rather oily, and where it touches it sticks. Moreover, parts charged to a potential differing from that of earth attract and retain light particles of dust. In some stations a small portable motor-driven air-compressor is used in order to blow the dust off electrical fittings, and the introduction of such appliances should not be discouraged. But it is not safe to rely on this method, partly because the general application of an air-blast tends to diminish the detailed examination of the insulating part of the board by the attendant, and partly because oily dirt is not moved by a current of air. The blast should be followed by a careful wipe-over by an intelligent human being armed with a piece of dry soft rag. Waste is not to be recommended, as it leaves fluff and loose strands lying about. In applying an air-blast, particular attention should be paid to resistance-frames and other inaccessible parts. It is not desirable to have the pressure of the air higher than 60 lbs. per sq. in., as cases have come within our knowledge where mica insulation has been stripped away by too great a blast of air. Where it is impossible to draw links in order to make a certain part of the board "dead," a feather brush mounted on an insulating handle may be used on systems at ordinary pressures of supply.

On many boards oil-break fuses are used, which have an occasional trick on breaking of distributing their oil fairly impartially over the surrounding apparatus. Oil is in itself an insulator, and, therefore, although it looks untidy, it is safe. But a streak of oil is a resting-place for all passing dirt, and if it is not soon removed the insulating properties of the board may be greatly reduced. On any board where oil is used, care must be taken that none gets upon insulation composed of rubber or wax, as they become deteriorated by its action.

It may not, perhaps, be out of place to draw attention at this point to the careful examination of fuses. Metal-strip fuses, it is notorious, deteriorate in course of time, and should be systematically replaced. A rough method of checking their behaviour is to test their temperature when on full load. When a particular fuse has an unusually high temperature, it should be marked for removal at the earliest possible opportunity. Quite apart from this, however, a fuse should not be allowed to remain in use for more than a year's running. Where oil-break fuses are used the level of the oil in them should be examined daily. Some types are constructed to break in air, the fused ends being then plunged in oil; other makers prefer to make the arc in the oil itself. In either case the oil must not get too low. Metal-vapour bridges a very wide air space, and hideous results may follow from the improper breaking of a fuse.

It is an unfortunate phenomenon in central station practice that many parts of the plant, originally put up as temporary plant, become by their good conduct permanent institutions. This is very much the case with switchboards, where opportunities of reconstruction are rare. Teak—a very slow burning wood—has been used for this purpose. It is oily, and so resists moisture. It should, however, be watched with an anxious eye by the engineer-in-charge. Asbestos, from some points of view, is better—it will not burn. But it absorbs any moisture it can find, and hence its insulating properties are diminished. If asbestos is used, it should be painted with some insulating varnish to remove this danger. The same remark applies to slate, whose enamel has been damaged by an arc. Precautionary measures of this description are worth any amount of brilliant evolutionary operations with burning switchgear in order to save the lights.

One of the functions of the switchboard is to register the amount of energy generated and distributed. The switchboard attendant is supposed to take a record every quarter or half-hour of his indicating meters, and to register the readings of his integrating meters at the end of his shift. If these meters are out of order, the proceedings become a solemn and arduous farce. The engineer should at least know how to adjust the zero of his indicators, and should do it. He should also check his machine meters against his feeder meters, one voltmeter against another, pretty frequently, and report faulty instruments. He should time his integrating instruments against his ammeters, and make sure there are no shunt current errors, friction losses, and so on.

It is, of course, impossible to enumerate all the points which require supervisory routine. Different types of switchboard develop various tendencies to failure, which have to be particularly watched. It is, however, safe to say that the engineer-in-charge will find that a conscientious scrutiny of his switchgear from time to time will amply repay him.

OUR LEGAL QUERY COLUMN.

[Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.]

"G. V. S." writes:—"Could you give us an opinion, in your Legal Column, as to the legality of the charges for current at 200 volts in the following case:—

"Some years ago our customer (Mr. X., we will call him) had his premises (a jeweller's shop) partially wired, having about 80 lamps fixed, and the Corporation supplied current at 100 volts; afterwards additions were made, but the Corporation would only allow them to be connected to the 200-volt mains, of course necessitating another meter. At this time the charge for current was 6d. per B.O.T. unit, with a rebate of 4½d.

"The Corporation electricity department are trying to get their customers on the 100-volt mains to change over to the 200-volt, and in the majority of cases the department carry out the necessary alterations and exchange of lamps free of charge to the consumer; but this they refuse to do in the case of Mr. X., and, naturally, Mr. X. is unwilling to do the work, more especially as all of his 100-volt lamps are either tubular or 'half opal' and more expensive than the usual type.

"Six months ago the department reduced their charges for 200-volt current to a flat rate of 4½d. per B.O.T., but they still charge Mr. X. for his current at the old rate (6d. per unit, with rebate to 4½d.), and refuse to put him on a level with the other consumers as far as his 200-volt supply is concerned, unless he will, at his own expense, make all necessary alterations to take a 200-volt supply throughout."

*** While it would seem that "G. V. S.'s" customer is being somewhat harshly treated by the Corporation, it does not appear that in refusing to pay the cost of the change of installation, that body is committing any breach of its statutory obligations. The consumer who continues to take a supply at 100 volts, is bound to pay for the same at the rates which he agreed to pay in the first instance. The only doubt about the legality of the action of the Corporation is suggested by Sec. 19 of the Electric Lighting Act, 1882, which provides as follows:—"Where a supply of electricity is provided in any part of an area for private purposes, then, except in so far as otherwise provided by the terms of the provisional order authorising such supply, every company or person within that part of the area shall, on application, be entitled to a supply on the same terms on which any other company or person in such part of the area is entitled under similar circumstances to a corresponding supply." It is conceived that the phrase "under similar circumstances" would be construed by the court to give power to a supply company to draw a distinction between consumers who take a supply at 200 volts, and those who take supply at 100 volts. The supply at 200 volts is cheaper than that at 100; and it is, therefore, reasonable that the company should be entitled to offer some small advantage to those who fall into line with the majority. Would it not be possible for the consumer whose case is under consideration to make some offer to the Corporation as to accepting half or some portion of the cost of the alterations?

Carlisle.—The Electricity Committee has entered into an agreement with the N.B. Railway to supply electricity to its yards and sidings at 2½d. per unit, the company guaranteeing a minimum consumption of 50,000 units per annum.

ACTION OF LIGHT ON THE FORMATION OF ACCUMULATORS.

Writing in the *Revue de l'Electricité*, Dr. D. Tommasi makes the following comments on certain criticisms relating to his experiments on this subject (see Electrical Review, LIV., p. 251):—

The fact which I observed recently concerning the action exercised by light on the speed of formation of accumulators * constitutes an entirely new observation which, for that very reason, has not been described in any treatise on accumulators.

It has been asserted that other observers knew before I did, of the influence of light on the formation of accumulator plates, but this is not quite true, and for these reasons:—

1. Because the effect of light or darkness on the rapidity of formation of negative plates has never been studied.

2. Also, because we have not yet discovered the part played by light or darkness in the rapidity of formation of positive plates, or even of plates of the Planté type.

The only observation of any interest that has been made is the demonstration that a leaden plate, covered previously with an electrolytic layer of peroxide of lead, undergoes a modification in colour by the action of light.

To establish this fact, M. Schoop cut two plates out of a sheet of lead which had previously been peroxidised by the Planté process, exposed one of them to the action of the solar rays and placed the other in darkness.

After some hours he found that the colour of the peroxide, black at first on both plates, was considerably modified on the plate that had been exposed to the light. In the solar light, the black tint had become dull red, whereas the plate that had remained in the darkness had kept its black colour.

From this it follows that M. Schoop only really studied the action of light and darkness on a leaden plate covered with electrolytic peroxide, and not on a positive electrode with oxide added during its formation, which is not by any means the same thing. The observations made with regard to the action of light on the peroxide of lead might be compared, rather, to those I made some time ago with regard to the action of light on the sub-chloride of silver. This is what I observed:—

When a silver plate is immersed for some minutes (10 to 15) in a solution of ferric chloride at 40°, it becomes covered with an extremely thin layer of dark violet sub-chloride of silver.

If this plate, after being washed and wiped, is then exposed to the action of light, we notice the singular fact that it becomes white, or, at least, its tint becomes paler, as with the peroxide of lead, the colour of which also becomes paler, passing from dark brown to reddish brown.

On exposing this plate, covered with sub-chloride, to different parts of the solar spectrum, I obtained the following results:—

Red Rays.—The tint of the sub-chloride becomes darker.

Yellow Rays.—The tint of the sub-chloride becomes a little darker, but not so much as in the red rays.

Green Rays—The tint of the sub-chloride becomes much paler.

Blue Rays.—The tint of the sub-chloride becomes as much paler as in ordinary light.

Violet Rays.—The tint of the sub-chloride becomes very slightly paler.

Would the same results be obtained if we exposed to the various rays of the solar spectrum a leaden plate covered with peroxide of lead?

THE TOMMASI ACCUMULATOR.

The more electric lighting and tramway stations are developed, says M. E. Guarini in the *Revue de l'Electricité*, the more do we appreciate the great advantages of batteries of accumulators as a reserve in case of need. But there is another field in which a brilliant future lies before the accumulator, viz., traction, at any rate as far as automobiles are concerned.

The qualities that are requisite in an accumulator for this purpose are strength, lightness, and great capacity, without reckoning others of a secondary order. One of the most suitable accumulators for this kind of traction is Dr. Tommasi's, especially his latest model. The results just obtained in the official trials of this type of accumulator are given below.

Trials on a car were carried out by M. H. Cuan-Artique, chief engineer to the Electromotion Co. for the construction of electric cars. These trials were made upon a battery of 100 ampere-hours capacity. The principal data were as follows:—Number of cells, 44; dimensions, 270 × 175 × 150 mm.; number of plates per cell, 15; weight of plates, 6 kg.; total weight with liquid, 10 kg. These elements were subjected to 45 charges at 25 amperes, and 45 discharges at 32 amperes. The capacity, after the fifth discharge, rose to 125 ampere-hours, and was maintained during the remainder of the tests. After various elements had been taken apart at the end of the tests, no active material whatever was found in the bottom of the boxes; the liquid was clear.

The elements were always charged until the voltmeter of the car gave 2·5 × 44 = 110 volts. The entire absence of any fall of material was observed, and the experimentalist considers that, under the conditions, this was a genuine advance.

* See the *Formulaire Physico-chimique*, by D. Tommasi, p. 437.

In the course of another test made by the same company it was found that after having subjected to 76 discharges two Tommasi accumulators, one of 15 ampere-hours and the other of 35 ampere-hours, and short-circuiting them six times, the active material remained perfectly adherent, and there was no trace of any deposit at the bottom of the boxes.

Some still more interesting experiments were carried out at the Central Electrical Laboratory of the Société Internationale des Electriciens, of which M. P. Janet is the director. They related to a Tommasi accumulator consisting of two positive plates and three negative plates placed in a glass box. The weight of the plates, deducting the weight of the terminals, was 2·680 kg., the weight of the terminals being 70 gr.

These particulars were furnished by the maker. The cell, having being brought ready charged to the laboratory, was subjected to a preliminary discharge at 2 amperes.

The tests included six charges and six discharges. All the charges were made at two amperes, and supplied to the cell about 50 ampere-hours. The discharges were made two at two amperes, two at 4, and two at 6. The first four were stopped when the difference of potential between the terminals fell to 1·75 volts, the last two when the electromotive force reached 1·8 volts.

The density of the liquid at the end of the charge was maintained at 1·24 (28° Baumé). The results are shown in the following table:—

No. of discharge.	Mean intensity in amperes.	Electromotive force. Volts.		Difference of potential Volts.			Electrical output A.H.	Energy output W.H.	Density of liquid at end of discharge
		Beginning.	End.	Beginning.	Middle	End.			
2	2·06	2·26	1·84	2·2	1·98	1·75	43·2	85·5	1·184
3	2·1	2·3	1·85	2·24	1·95	1·75	43·2	84	1·20
4	4·05	2·24	1·86	2·18	1·94	1·75	35·3	68·5	1·20
5	4·06	2·22	1·87	2·16	1·94	1·75	32·5	63·5	1·20
6	6·2	2·26	1·80	2·16	1·93	1·6	29·1	56	1·21
7	6·1	2·28	1·82	2·09	1·93	1·6	28·5	55·5	1·24

Another test was made in the same laboratory on a Tommasi accumulator consisting of five plates placed in a glass trough.

The weight of the five plates, deducting the weight of the terminals, was 2 kilogrammes, the weight of two positives and two negatives being 1·6 kg. The tests included seven discharges and six charges.

The cell, having arrived charged at the laboratory, underwent a preliminary discharge at 2 amperes. The six charges were effected at 2 amperes, so as to supply to the element about 50 ampere-hours. Of the six discharges two were performed at the mean rate of 2 amperes, 2 at the mean rate of 4 amperes, and they were stopped when the difference of potential between the terminals fell to 1·75 volts.

The last two, effected at the mean rate of 6 amperes, were stopped when the electromotive force reached 1·8 volts.

During all these trials, the density of the liquid was maintained to the end of charge at 1·24 (28° Baumé). The results of these tests are shown in the following table:—

No. of discharge.	Mean intensity in amperes.	Electromotive force. Volts.		Difference of potential. Volts.			Electrical output. A.H.	Energy output. W.H.	Density of liquid at end of discharge
		Beginning.	End.	Beginning.	Middle	End.			
2	2·07	2·23	1·81	2·24	1·95	1·75	38·5	74·5	1·2
3	2·09	2·31	1·80	2·26	1·95	1·75	38·6	73·8	1·2
4	4·1	2·28	1·84	2·22	1·94	1·75	32·4	65	1·21
5	4·01	2·32	1·81	2·24	1·94	1·72	32·3	63	1·21
6	6·2	2·32	1·80	2·20	1·93	1·64	29·6	57·2	1·25
7	6·03	2·30	1·80	2·24	1·91	1·61	28·3	54·2	1·23

THE DEVELOPMENT AND IMPORTANCE OF FIRE CALLS AND ALARMS.*

By JAMES SHEPPARD, A.I.E.E, Surveyor, North British and Mercantile Insurance Co.; Chairman, Library Sub-Committee, British Fire Prevention Committee.

The application of the electric telegraph made it possible to dispense with calls by messengers or other means, and the use of telegraphic fire alarms gradually superseded previous methods of giving "calls" to fire brigades.

The first complete system of public electric fire alarms was provided in connection with police stations in Berlin in 1849, other cities experimented, and after a time adopted similar systems of alarm signals.

The fear of false alarms, either from defects in the equipment or from malice, delayed general approval of public electric alarms, and

* Abstract of paper read at the International Fire Service Congress, Budapest.

they were not adopted in London until 1880, when 40 call points on six circuits were provided, from which in that year 44 good calls were received and 33 false alarms, but only in one instance was a person detected in tampering with the alarm.

The London Fire Brigade has now 927 public electric alarm points in addition to 264 telephone lines to police stations, public, and other buildings; from most of the alarm points telephonic communication can be at once established with a police station.

Since the fixing of electric call points in the streets of London, the proportion of false alarms has increased from about 7 per cent. of all calls for fires to about 20 per cent, but notwithstanding this, the system is admitted to be indispensable and of great public utility. Malicious alarms now show a marked decrease, the number of these reported in 1903 being 126.

Various arrangements are made in different cities to guard against the abuse of electric call points, but all these tend to cause delay, and may prove the greater of two evils.

As an addition to the public electric fire alarm call-boxes, numerous call points are now provided on the different floors of large establishments in American cities, and probably in some cities of other countries, connected with the nearest public alarm box, through which alarms can be sent direct from various parts of the building so equipped to the fire brigade stations or to a central depôt in telephone communication with the brigade.

Wireless telegraphy has been used for fire alarm purposes, and may prove of value in special circumstances.

All the systems above referred to, rely on some person discovering an outbreak of fire and operating the alarm, and are, therefore, known as manual alarms; these have been found to be generally satisfactory, especially in connection with a suitably organised fire watch.

Many efforts have been made in the past to secure an automatic alarm operating on an undue increase of temperature in any part of a building, and thus announce the outbreak of fire, but these devices were not found to be permanently reliable. In more recent years renewed efforts have been made in this direction with every prospect of success.

In automatic sprinkler installations the provision of alarms operating on the opening of a sprinkler head, whether from heat or leakage, are indispensable. In other systems, any of which can be used in connection with sprinklers, devices known as heat detectors or thermostats, are distributed over all parts of the building to be protected. Any one of these on an increase of temperature up to a point determined, make or break an electric circuit and transmit an alarm to any point desired indicating the building, floor, or room, from which the alarm is given.

Various applications of the law governing the changes of different substances under the action of heat, have been devised for securing the end in view, such as the melting of specially prepared solder, expansion or changes in springs or rods of metal, or of mercury in tubes, expansion of air operating an elastic metal diaphragm, air pressure or vacuum release, expansion of liquids breaking slight glass bulbs, elongation of wire. In a device recently introduced, the elongation of wire and the release of air under pressure, are used in combination, both for giving an alarm and for opening the main valve of a sprinkler installation, the sprinkler heads being opened by a similar but distinct wire elongation. The alarm can be given at any point required by an automatic electric current. In many cases automatic fire alarms are maintained and controlled by the companies supplying them, all alarms being received by officers of the companies referred to at the fire station, or at separate central stations, from which they are transmitted by telephone to the fire station, with full particulars as to locality. This latter arrangement is followed in London, a fine of £10 being payable if a false alarm is given.

The various systems may be said to be still on their trial, from which the outcome will be the survival of the fittest.

The foregoing remarks apply more particularly to Great Britain, but it will be found that the practise and experience has not differed in other countries to any great extent, except that in some cases improved methods were adopted at an earlier date than in the country named.

The advantage gained by a fire brigade receiving the earliest possible notice of the outbreak of fire cannot be over-estimated, and any system which secures this in a reliable manner will be a distinct public benefit. The National Convention of Fire Chiefs of the United States unanimously resolved at their meeting in 1871, that a thorough and efficient system of telegraphic fire alarms, which shall give early and definite information of the existence and locality of a fire, is of primary importance to the fire department of every city and town. This resolution will doubtless receive universal approval.

While fully acknowledging the supreme importance of early alarms of fire, it is, at the same time, desirable to emphasise the equal importance of planning, construction, and protecting commercial and other buildings, both internally and externally, so as to check the rapid spread of fire, and thus afford fire brigades reasonable opportunity of preventing conflagrations. Experience has repeatedly shown the necessity of this, even in cases where the premises involved have been installed with sprinkler or automatic alarms.

The concentration of business with changes in the manner of conducting them, the storage and general use of new and highly-inflammable substances, new modes of artificial lighting and other causes, have increased the fire dangers to an extent fully equal to the improved methods of fighting fires which automatic fire alarms, up-to-date water supplies and extinguishing appliances provide, so that while facilities for dealing with fires have been enormously increased, the fire dangers have also correspondingly increased, leaving the net gain practically nil.

The building in which the Baltimore conflagration originated was fitted with automatic fire calls which gave an alarm to the Fire Patrol and Engine Co. situated two blocks distant, but in consequence of the large undivided area of the building, the existence of wide opening through all floors from basement to roof, and wood linings to walls and ceilings, the early call was to no avail.

The great danger constantly present where large warehouses filled with combustible goods like the Hurst building at Baltimore, are in proximity to each other, has been often referred to.

Twenty years back Capt. Shaw published the following remarks on the subject:—"At the present rate of progress the day cannot be far distant when firemen may be compelled to say that they are unable to deal with the vast masses of property which merchants insist on bringing together within one risk; but it is hard on a fireman to have to own himself beaten even when he knows he is, and it is still possible that in the end the quantity of stock massed together on one risk will be limited not by the warning or appeal of firemen, but by the self-interest of merchants when they find insurance rates prohibitive."

Since the foregoing was written, its truth has been shown by the costly experience of many cities.

Budapest, with other important cities of Eastern Europe, have adopted measures by which sweeping conflagrations have been avoided. It will be of great service if some members of this Congress will give particulars of these measures which have given such satisfactory results.

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

19,113. "Wireless telephony." J. A. S. Arnold. September 5th.

19,125. "Improvements in brush-holders for electrical machines." B. G. Lamme. (Date applied for under Patents Act, 1901, September 16th, 1903, being date of application in United States.) September 5th. (Complete.)

19,126. "Improvements in or relating to dynamo-electric machines." W. H. Foot. (Date applied for under Patents Act, 1901, September 16th, 1903, being date of application in United States.) September 5th. (Complete.)

19,160. "Improvements in telephone cord." E. G. Sievert. September 5th. (Complete.)

19,168. "Improvements in and relating to alternating current and electrical machinery." W. P. Thompson. (Berliner Maschinenbau Act.-Ges. vorm. L. Schwartzkopff, Germany.) September 5th. (Complete.)

19,198. "Improvements in the construction of life-guards applicable to electric tramcars and the like." J. N. Fidler and S. W. Fidler. September 6th.

19,232. "Improvements in or relating to electric arc lamps." A. Blondel. (Date applied for under Patents Act, 1901, September 9th, 1903, being date of application in Belgium.) September 6th. (Complete.)

19,242. "Improvements in and relating to electric light fittings." H. Lea and S. Mitchell. September 6th.

19,245. "Improvements in automatic signalling for electric railways or tramways." R. P. Wilson and A. G. Marshall. September 6th. (Complete.)

19,265. "Improvements in indicating devices for electrical fire alarms." R. Hoenicke. September 6th. (Complete.)

19,305. "Improved electric interlocking apparatus for operating electrically-worked signals and points." E. M. T. Boddam. September 7th.

19,326. "Improvements connected with electric hand-switches for motor cycles and other light purposes." J. F. Janes. September 7th.

19,333. "Improvements in means for eliminating the effects of induction in telephone systems and the like." J. Young. September 7th.

19,334. "Improvements in electric motors." The firm of Reiss & Klemm. (Date applied for under Patents Act, 1901, October 12th, 1903, being date of application in France.) September 7th. (Complete.)

19,341. "An improved bearing for use on motors, dynamos, or other machines." T. Haynes. September 8th.

19,343. "Regulating trolley head for electric cars." J. Murphy and P. Goodier. September 8th.

19,364. "Combined driving gear and brake for electric cranes." J. W. Branston. September 8th.

19,365. "Improvements in, and connected with, metallic conduits for electric wires and cables." W. H. Isherwood. September 8th.

19,419. "Means for removing static electricity from paper, yarn, power belts, and other articles or substances charged therewith." W. H. Chapman. September 8th.

19,423. "Improvements in the internal insulation of tubes and fittings for electric conduits." T. Taylor. September 9th.

19,440. "Improvements in or relating to electric switches." W. H. Isherwood. September 9th.

19,475. "Improvements relating to electric cranes or the like." O. Imray. (Siemens Schuckert-Werke, G.m.b.H., Germany.) September 9th.

19,478. "Improvements in regulators for electric circuits." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) September 9th.

19,479. "Improvements in electric meters." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) September 9th.

19,482. "Improvements in electric automatic block signal and safety systems." G. P. Finnigan. September 9th. (Complete.)

19,500. "Improvements in electric meters of the mercury electrolytic type. A. Wright. September 9th.

19,502. "Improvements in electrolytic meters for alternating currents." A. Wright and H. F. Reason. September 9th.

19,506. "Improvements in connection with wall sockets and switches for electric circuits." G. E. Fletcher. September 10th.

19,540. "An improved combined rail and road electric tramway system and vehicles therefor." J. Dixon and T. O. Dixon. September 10th.

19,561. "Improvements in and relating to trolleys for electric tramways." J. Honnette and H. Gerhardi. September 10th. (Complete.)

19,572. "Improvements in means for controlling circuit breakers." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) September 10th.

19,574. "Improvements in motor control systems." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) September 10th.

19,580. "Improvements in electric meters." T. Duncan. (Date applied for under Patents, Act, 1901, December 19th, 1903, being date of application in United States.) September 10th. (Complete.)

15,590. "An improved casing or conduit for electric conductors." M. M. McHardy. September 10th.